ELECTRICAL REVIEW
AND
WESTERN ELECTRICIAN

VOL. LIV, No. 15 CHICAGO, SATURDAY, APRIL 10, 1909. ISSUED WEEKLY

BY THE
ELECTRICAL REVIEW PUBLISHING COMPANY.

CHARLES W. PRICE, President.
H. S. TUTHILL, Secretary. PHILIP S. DODD, Manager.
C. W. FORBRICH, Assistant Treasurer.

PUBLICATION OFFICE: 204 DEARBORN STREET, CHICAGO.

EASTERN DEPARTMENT . . . . . 13 Park Row, New York.
E. E. Wood.

EUROPEAN OFFICE . . . . . 42 Old Broad Street, London, E. C.
Henry W. Hall.

A. A. GRAY, Managing Editor.

The present publication comprises: ELECTRICAL REVIEW, VOL. LIV, No. 15; WESTERN ELECTRICIAN, VOL. LIV, No. 15.

SUBSCRIPTIONS

One Year, United States	$3.00
One Year, Canada	4.00
One Year, Foreign Countries	6.00
Single Copy, 10 cents. Back numbers, beyond one month, each	.25

Changes of address reaching this office later than Monday cannot be made until the issue next following.

Entered as second-class matter, November 7, 1908, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

CONTENTS.

EDITORIAL:
An Important Trolley Issue in Massachusetts 645
The Cost of Gas and Electric Candlepower 646
Electricity in the Astronomical Observatory 647
The Electric Vehicle 647
Electrical Papers at the London Physical Society 648
Electric Trackless Trolley Omnibuses in Vienna and Other European Cities 650
Hudson-Fulton Fund 651
New Electric Welding Process 651
Increasing the Popularity of Electric Vehicles, by Frank B. Rae 652
Abuses of Storage Batteries in Electric Vehicle Work, by Walter L. Thompson 653
Electric Drive in English Cotton Mills 654
Central Stations and the Electric Automobile 655
New Subway for Boston 657
The Relation of the Central Station to the Automobile Business 658
Mechanical and Electrical Exposition at Worcester, Mass 659
Wireless for Milwaukee Plant 659
Alternating Currents and Their Applications, by Edson R. Wolcott 660
The Industrial Application of the Electric Motor in Steel Mills, by B. R. Shover 661
Electrical Notes from Great Britain 664
New Army Rifle with Electrically Lighted Sights, for Night Use 665
Small Progress on Illinois Central's Electrification Plans 665
Mono-rail System for New York City 665
New York City Traction Operations 666
Industrial Education to be Discussed by the American Institute 666
New England Street Railway Club 666
Preliminary Program for the Institute Convention 667
Ithaca Section, American Institute of Electrical Engineers 667
New York Section, Illuminating Engineering Society 667
National Association of Cotton Manufacturers 667
Public Service Corporation Dinner 667
The Ventilation of the Flaming Arc, by R. F. Pierce 668
FINANCIAL REPORTS OF ELECTRICAL COMPANIES 668
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 670
Pennsylvania House Passes Subway Bill 671
INDUSTRIAL SECTION:
Sangamo Ampere-Hour Meter 672
The Westinghouse Storage-Battery Auto Truck 673
Brill Company Increases Forces 673
Special Transformers for Use in Connection with Low-Voltage Tungsten Lamps 674
Deltabeston Wire Stands Severe Heat and Moisture Tests for Magnet Wire 674
The Herrick Planigraph 674
Combined Oscillating-Rotating Fan Motor 674
The Electric Flat-Iron Campaign in Chicago 675
Economic Power Company Loses Suit 675
Public Service Commission Approves McAdoo Subway Extension 675
The Museum of Safety and Sanitation 675
Electric Vehicles—1909 Models 676
CURRENT ELECTRICAL NEWS 683
DIRECTORY OF ELECTRICAL AND ALLIED ENGINEERING AND SCIENTIFIC SOCIETIES 687
RECORD OF ELECTRICAL PATENTS 689

Copyright, 1908, by Electrical Review Publishing Co.

AN IMPORTANT TROLLEY ISSUE IN MASSACHUSETTS.

Strange as it may appear to those who regard the East as over-developed, there are a considerable number of towns in Massachusetts today which are entirely without steam or electric-railroad facilities. Several bills before the Massachusetts Legislature are of more than local interest in their bearing upon the revival of decadent communities by the electric railway. The Berkshire Hills district of the state is practically unanimous in its desire for electric-railway facilities, but the territory is so sparsely settled that the projects halt for lack of money. The New York, New Haven & Hartford Railroad Company, a steam system of large resources, stands ready to develop this section of the state if the necessary legislative sanction can be obtained for the company to build, control and operate these trolley lines. The railroad interests feel that by using the electric lines as feeders the development can be financed, while a considerable sentiment in other parts of the state is strongly opposed to authorizing steam railroads to own trolley systems.

The local case is very simple. Private capital cannot be depended upon to develop the facilities needed. The local towns have impoverished themselves in trying to gain access to the outside world. A steam railroad which would benefit in its long-distance traffic by opening up new fields of business through the construction of electric feeders can afford to do what private enterprise, looking no further than the immediate returns from the trolley itself, cannot undertake. It seems clear that unless the railroad company is permitted to take hold of the situation and spend upward of two million dollars in construction in this territory, nothing will be done; and the diminishing population, shrinking commerce, and depleting farms of a beautiful section half as large as the state of Rhode Island will continue their downward progress.

The broad significance of such a case as this is the power of electricity to revitalize a community, no matter whether the application be in the telephone, power supply or transportation field. In the long run the question of ownership is less important than the provision of the necessary facilities, especially in a state where regulated monopoly has been so successful. It is impossible to estimate the benefit which the telephone has become in these hill towns. Sooner or later Massachusetts must realize that the demand for electric service is a world-wide movement, and sooner or later the rising tide of electrical application will submerge the lesser questions of utility control by one class of public-service corporations.

THE COST OF GAS AND ELECTRIC CANDLEPOWER.

Comparisons are often made between the costs of gas and electric candlepower on the basis of official gas tests, but such figures are far from indicating the true relative costs of light to ordinary consumers.

The usual statement of costs runs about like this:

Take sixteen-candlepower gas at, say, one dollar per thousand feet, and electric energy at ten cents per kilowatt-hour. A sixteen-candlepower gas gives this illumination when consumed at the rate of five cubic feet per hour at a certain burner and under the conditions of low and uniform pressure that are maintained at the testing station. If some other than the testing burner be substituted, or if a high or variable pressure be encountered, the actual candlepower of the gas may be much lower than that shown by the official figures, as will appear later.

With the assumed quality and price of gas the cost of a sixteen-candlepower light per hour is 0.5 cent, under the conditions that obtain in the testing station. If this same gas be tested with a mantle burner, a consumption of three cubic feet per hour, costing 0.3 cent, may give as much as fifty candlepower, when the mantle is new.

An ordinary fifty-watt, sixteen-candlepower carbon lamp consumes energy costing 0.5 cent per hour, at the rate of ten cents per kilowatt-hour, but the energy for a twenty-five-watt, twenty-candlepower tungsten lamp costs only 0.25 cent per hour at the same rate.

On the assumptions made, it thus appears that the cost of an open gas burner and of a carbon lamp are on a par for a sixteen-candle light, while the tungsten filament gives twenty-five per cent more light at one-half the cost of the gas flame or the carbon lamp. If a mantle burner is employed, however, the light obtained is two-and-one-half times that of the twenty-candle tungsten lamp, at an increase of twenty per cent in cost. These figures take no account of the cost of burners, mantles or lamps, or of the loss of candlepower with age.

In some cases the burner used for testing gas gives higher candlepowers than those in general use are capable of doing, but this point may be waived for the present. Again, in testing gas candlepower a suitable and uniform pressure is maintained at the burner by means of a regulator, so that the gas is consumed at a proper and uniform rate, but consumers are obliged to receive gas from the mains at variable pressures that may be too high at one time and too low at another.

Some examples on this line are found at page 91 of the report of the New York Public Service Commission, Second District, for the year 1908, where the hourly consumption of gas at different pressures is recorded for several burners. From this record it appears that a No. 7 Slit Union Bray burner, the very burner that the New York law prescribes for testing mixed coal and water gas, and for water gas, on the basis of five cubic feet per hour, actually consumes 11.64 cubic feet of gas per hour at a pressure of three inches, which pressure is very common at the meters of consumers. This burner gave no warning of improper consumption by blowing until the pressure reached 2.4 inches and the gas was passing at the rate of 10.27 feet per hour.

In this same set of tests, three other burners consumed 10.24, 10.89 and 14.5 cubic feet of gas per hour, respectively, at a three-inch pressure. One of these burners began to blow at three inches when passing 10.24 feet of gas per hour, another blew at two inches with gas flowing at the hourly rate of 8.6 feet, and the third burner blew at a pressure of 4.7 inches with a gas consumption of 17.2 cubic feet per hour. Several other burners consumed gas at rates less than those just named, though only one of the nine burners tested passed less than seven feet of gas per hour, at the three-inch pressure.

While the pressures at the meters of most gas consumers range between two and three inches or more, it is obviously incorrect to compare the cost of gas for burners that consume only five cubic feet per hour, usually at a pressure less than one inch, with the cost of operating electric lamps. From the tests just quoted, it seems that an ordinary open burner that would pass only five feet of gas per hour under laboratory conditions may consume as much as ten feet per hour at the pressures commonly supplied to consumers.

At the rate of one dollar per thousand feet for gas, the operation of an ordinary open burner will thus often cost one cent instead of one-half cent per hour. It is no answer to say that the larger consumption of gas gives more light, for in many situations the consumer wants only sixteen or twenty candlepower.

What has been said as to the increased consumption of gas at open burners over the figures recorded for laboratory tests applies in general to mantle burners also. Though a mantle burner may be rated for three feet of gas per hour, the gas actually consumed will depend on the pressure at the burner and on the point at which the adjustment of the burner is set. If the burner is adjusted for a consumption of three feet of gas per hour at 1.5 inches pressure, the flow of gas will rise to about 4.2 feet per hour at a three-inch pressure. When fully open, a standard make of mantle burner rated to consume about three feet of gas per hour has been found to pass 5.4 feet of gas hourly, at the pressure of 1.1 inches of water.

In spite of the large increase of lighting efficiency in the gas mantle over the open burner, the latter appears destined to hold its place with the great majority of consumers, as it has certainly done so far. On this point it is of interest to note the recent testimony of a gas expert before a committee of Congress, as follows:

"The use of the incandescent burner, what is known as the Welsbach burner, is very limited, if you consider the entire amount of gas consumed. I think I am safe in saying that in New York city not twenty per cent of all the gas consumed by the public generally is used in that way. The old flat-flame burner is the burner of today. One cannot judge by the appearance of shops, well-lighted store windows, and things of that sort. That does not give any indication of the burners used by the great mass of gas consumers. * * * I have only one mantle in my house."

ELECTRICITY IN THE ASTRONOMICAL OBSERVATORY.

The range of successful applications of electricity continually widens, and from the heaviest to the most delicate task there seems to be nothing which cannot be handled better by electrical than by the old hand or mechanical means. The place of electricity in the scientific laboratory has long been assured, but it is only recently that the astronomical observatory has found out that its work can be done more conveniently by electrical methods, particularly in the manipulation of heavy telescopes. The electromagnet has long been indispensable in the accurate measurement of time, and the transmission of observatory signals each day at noon to all parts of the country is familiar to every close observer of telegraphic methods. The use of miniature incandescent lamps to illuminate the cross-hairs of astronomical instruments used in measuring transits of heavenly bodies is coming more and more into favor. It is in the field of telescope driving, however, that the most important electrical improvements are now being applied. Recent work of the Harvard Observatory at Cambridge, Mass., along this line deserves special mention on account of its significance to other astronomical plants and its interest to the central station as a small power consumer of unique character.

For generations the accepted method of telescope driving for sustained observation has been by clockwork and weights. The design and construction of the driving clock demands high accuracy for successful and permanent operation; it is correspondingly a costly adjunct of the observatory, and such apparatus is difficult to maintain in correct adjustment. By the introduction of the small motor under accurate automatic control, the driving problem has been solved at Harvard at moderate first cost, with convenience of manipulation and relative simplicity of the mechanism. Electricity has been used before in winding the weights of driving mechanisms and in the longer swinging movements of high-powered instruments, but the direct operation of a heavy telescope by a motor under the control of an accurate clock is a late development.

About a year ago a twenty-four-inch reflecting telescope was equipped with the motor drive at the Harvard Observatory; a few months later the celebrated telescope, formerly owned by Dr. Common, a reflector sixty inches in diameter, was provided with electrical propulsion. In a recent article in the Boston *Transcript* on the equipment of this powerful instrument, Miss Grace Thompson states that this is the largest telescope in the world at the present time. Its polar axis is supported in a tank of water, the instrument being located in the open, while the observer carries on his work in a comfortable building. By means of a small switchboard at the desk of the observing room the telescope can be swung by motors into any operating position, the exact angles and directions being electrically indicated to the astronomer on duty.

The most delicate electrical application is the means adopted for following the apparent motions of the stars under observation by automatic methods. The apparatus consists of an electric motor connected to the driving gear of the telescope, current being supplied from an ordinary power circuit. The switch controlling the motor circuit is operated by an electromagnet in a battery circuit of low potential. This auxiliary circuit also includes a contact device operated by the pendulum of the controlling clock, and a releasing contact, which is momentarily opened at each revolution by a wheel in the telescope, which, when driven at the proper rate, revolves in a period corresponding to that of the synchronizing pendulum. An interlock is provided on the control magnet, so that when the circuit is once closed by the clock, it cannot be opened except by the breaking of the releasing contact on the telescope. A flywheel is provided on the telescope, and this tends to carry the great glass, weighing many tons, forward steadily as the intermittent impulses are applied to it by the motor. The results have been so favorable that it has been practically decided to operate all the other large instruments at the Harvard Observatory by electricity, and it is only a question of time when the older methods of driving will be entirely superseded, where possible under the local conditions, by electric power, to the general convenience of all large-scale astronomical research.

THE ELECTRIC VEHICLE.

On other pages of this issue there will be found considerable information concerning the care and use of storage batteries, the relation of central stations to the automobile business, and some descriptive matter concerning the 1909 models which the electric vehicle builders are offering to the trade.

Judging by the number of electric vehicles now seen upon the streets of all cities where proper charging facilities have been established the electric pleasure wagon has come into its own. The number of electric power wagons has not reached such large proportions, but there is every indication that the utilization of this form of truck has only just begun, and that there is a great future in store for it.

There are many questions to be considered in taking up seriously the matter of still further increasing the popular use of the electric vehicle and power wagon. There is an intimate relation between the running gear, the transmission system, the body of the car, the batteries and the tires. These must be arranged so that each element will work in harmony with the other. Carelessness in charging the storage batteries, indifference to nicety in detail in connecting the batteries to the motors, slovenly adjustment of the mechanical parts, or unskillful driving of the car itself, may all tend to impose undue strains upon the equipment, and so reduce the effective range or radius of travel of the machine.

The proper rate for charging: Whether it will be a flat rate, based upon a general average; a rate based upon a mileage, or upon frequency of charging; a sliding scale based upon mileage or kilowatt-hour demand, or a fixed rate per kilowatt-hour demand, plus a charge for cleaning, repairing and housing. This must be discussed and a sort of standard arrived at. Already there are as many advocates of different methods as there are alternatives.

Electrical Papers at the London Physical Society.

At the last meeting of the Physical Society of London a number of electrical papers were discussed. The following is an abstract of the proceedings:

A paper on the "Effective Resistance and Inductance of a Concentric Main, and Methods of Computing the Ber and Bei and Allied Functions" was read by Dr. Alex. Russell. The author gives the solution of the problem in terms of Kelvin's ber and bei functions and of two analogous functions which he calls ker and kei functions. The formulæ given previously by Maxwell, Rayleigh, Heaviside, Kelvin and Sir Joseph Thompson are shown to be particular cases of his solution. Simple formulæ for calculating the functions used are obtained and are employed to correct errors in the tables given by Kelvin and also by Mascart and Joubert. The following simple formula for the effective resistance R, per centimetre length, of the inner conductor of a concentric main for high-frequency currents is obtained:

$$R = (\rho m/2\pi a)\ (0.7071 + 1/2ma + 0.265/m^2a^2 - 0.35/m^4a^4,$$

where ρ is the volume resistivity of the conductor, a its radius, $m^2 = 8\pi^2\mu f/\rho$, μ the permeability of the conductor, and f the frequency of the alternating current. This formula may be used in wireless telegraphy, for calculating the resistance of a conductor when other conductors carrying high-frequency currents are not too close. For values of $m\,a$ greater than six the maximum inaccuracy of the formula is less than one in 10,000.

In obtaining the solution, exact formulæ are obtained for the density of the current at all points on the inner and outer conductors.

The case of a concentric main with a hollow inner conductor is also considered. The method of obtaining the complete solution is explained, and approximate formulæ suitable for power-transmission cables are given and numerical examples worked out. The approximate formula for the effective resistance at low frequencies, the proof of which is very laborious, has been previously obtained by Oliver Heaviside, and the author's solution is an independent verification of its accuracy. For high frequencies the formulæ become much simpler, and for very high frequencies the ordinary well-known formulæ are obtained. The formulæ given enable us to find the impedance of a concentric main, taking into account the variation of the current density over the cross-section of both conductors and the distributed capacity.

In opening the discussion, W. Duddell remarked that it was customary in dealing with high-frequency currents to use several parallel insulated wires instead of a single wire in order to increase the surface and obtain greater conductivity. He asked the author to what extent it was advisable to do this. He also asked how far it was valuable to silver-plate copper wires for high-frequency currents.

A. Campbell observed, with regard to Dr. Russell's warning that inductance standards might be greatly dependent on frequency, that well-designed single-layer wavemeter coils of highly stranded wire did not show, according to his experiments, a variation of more than one or two in 1,000 in their self-inductance for frequencies from zero up to 1,000,000 cycles per second, the actual inductances being from ten to 200 microhenries.

W. H. Eccles remarked that in high-frequency work the resistance of a conductor depended on the nature of the surface. If a copper wire tarnished, its resistance altered. Uniform results could be obtained by lacquering the wires.

B. S. Cohen said a knowledge of the variations with frequency of effective resistance and inductance of copper conductors was of considerable importance in connection with telephonic transmission, and it was to be hoped that Dr. Russell would extend his valuable investigations to conductors lying side by side. The heaviest gauge of conductors met with in general telephonic practice is 2.85 millimetres in diameter in the case of cables, and these conductors are separated by about 2.5 millimetres of combined paper and air dielectric and twisted together with a lay of about fifteen centimetres. In the case of overhead open wires, the largest conductor in general use is four millimetres in diameter. The mean axial distance apart of these conductors is about thirty-five centimetres, as they are rotated in sets of four in a foot square. Applying Lord Rayleigh's formula for effective resistance in these cases, we get, for a frequency of 1,500 cycles, an increase of one per cent in effective resistance over steady current resistance in the case of the 2.85 millimetre cable wire. A frequency of 1,500 cycles can quite safely be taken as the maximum frequency which is of any importance in speech articulation. The increase with the 5.69-millimetre open wire at this same frequency is twelve per cent, and with the four-millimetre wire it is 3.55 per cent.

Dr. Drysdale made a suggestion for facilitating the use of these and other calculations. Electrical measurements frequently necessitated the employment of higher functions, and this involved either troublesome calculations or the compilation of bulky tables. He had therefore been led to try whether graphical methods could not be employed. The plotting of a function $f(x)$ graphically could only give values to a low degree of accuracy, but if some simple empirical formula $y = \phi(x)$ were found which approximated to the required function, it was possible to express the true value $f(x)$ in the form $r\phi(x)$ or $\phi(x) + a$, where r or a might be termed a correcting factor or term, which only varied between comparatively narrow limits. By employing a curve in which log r or a was plotted against x, it was frequently possible to obtain values of a function from a single curve correct to one in 10,000 or closer, and which greatly assisted interpolation. He had found this of great service in dealing with elliptic integrals, and solid angles, and thought that it might perhaps also be applied to the ber and bei functions.

The author, in reply to Mr. Duddell, stated that in his opinion stranding and insulating the strands of the wires used in wireless telegraphy would not diminish the skin effect, if the strands were parallel to the axis of the wire. It would probably increase it. Silver-plating the wires would be beneficial. The distribution of the high-frequency current on the surface of the wires can sometimes be found by remembering that the distribution is such that no magnetic induction is produced in the metal. With ordinary laboratory coils a frequency of 10,000 will alter their inductance two or three per cent. If we have two parallel cylindrical wires practically touching, the inductance will alter from 3.7726 centimetres per unit length to practically zero as the frequency is increased. A piece of metal adjacent to the wire would in many cases modify the skin effect, but it would be difficult to deduce any general rule, as the main current is affected in different ways by the induced eddy currents in the neighboring metal according to the relative positions and magnitudes of the metal and wire.

A paper entitled "Note on the Luminous Efficiency of a Black Body" was read by Dr. C. V. Drysdale. The importance

of efficient methods of light production renders it of interest to ascertain the possibilities of a black body as a light radiator at various temperatures, and the writer has attempted to obtain these from the radiation formula of Wien. The energy radiated between any two wave-lengths is written down and the total radiation calculated. This in conjunction with Kurlbaum's determination of the radiation constant, and Lummer & Pringsheim's results give rise to the formulæ given in the paper. A table and curves calculated from these formulæ have been worked out by Mr. A. F. Burgess, B.Sc., and show the relation of the total and luminous radiation and luminous efficiency for various temperatures. The comparison of the luminous energy so calculated with the intensity of light radiation found by Professor Féry leads to a mechanical equivalent of light of about 0.075 watt per candle, which is a fairly probable figure. The results show the enormous extent to which the luminous efficiency is dependent upon the temperature and how extremely low it is at ordinary temperatures. At 1,500 degrees centigrade the efficiency is only of the order of one per cent or less, while at 2,000 degrees it is about three per cent. The highest efficiency is obtained at about 6,500 degrees centigrade, and is then only between forty and fifty per cent. This strongly points to the necessity for working in the direction of selective radiation or luminescence.

Dr. Russell thought that the physiological effect on the eye ought to be considered. The sensibility of the eye to light rays varied, not only with the wave-length, but also with the intensity of the rays and the time during which they had been acting on the retina. If we only consider the objective stimulus of the luminosity, the author's implied definition might be, he thought, accepted. But if we consider, as we ought, that the subjective sensation produced in the eye has to be taken into account when judging luminous efficiency, another definition is required and the problem becomes more complicated.

A paper on "The Use of the Potentiometer on Alternate-Current Circuits" was read by Dr. C. V. Drysdale. The great difficulty in alternate-current measurement lies in the shortness of the range of the instruments available, and there is therefore a great need for some instrument which, like the direct potentiometer, should be capable of measuring potential differences and currents of any range with accuracy. Two methods of attempting to apply the potentiometer principle to alternate-current measurements seem possible: (a) The balancing of the alternate-current potential difference against a continuous potential difference with the assistance of some suitable balancing device, or (b) the balancing of two alternate-current potential differences against one another. Suggestions or attempts at potentiometers on the first principle have been made, but seem unlikely to be successful, owing to the insensitiveness of square-law instruments at low voltages. The second method presents difficulties in that the two potential differences to be compared must be identical in magnitude, phase and frequency, and approximately so in wave-form. The author's recent experiments with a phase-shifting transformer have led him, however, to attempt to use it with a potentiometer, and the measurements are then made in the same manner as with an ordinary direct-current potentiometer, except that a vibration galvanometer or telephone is substituted for an ordinary galvanometer. By interposing an ammeter on the dynamometer principle in the main circuit of a potentiometer and deriving the current from the secondary of a phase-shifting transformer, it is possible to check the instrument with direct current against the standard cell in the ordinary way, and then to reproduce the same current in the potentiometer circuit and to bring it into coincidence of phase with the potential difference to be measured.

Experiments have been made with this device by A. C. Jolley and the author, first as to the accuracy of current measurement using an ordinary low-resistance standard, and have been found to give very good agreement with a Kelvin balance. Other tests have been made to obtain the vector difference of potential across a resistance coil and a choking-coil connected in series, and the triangle of voltages so formed was found to be very nearly closed. The tests so far made seem to indicate that an alternate-current potential difference of 0.1 volt can be measured to an accuracy of 0.2 per cent or closer. The author has also designed a universal potentiometer on this principle which serves both for direct- and alternate-current measurements, and for testing potential difference, current, phase, power, inductance, capacity, etc.

Mr. A. Campbell remarked that the vibration galvanometer was so very much more sensitive for its own frequency than for others, that it would not be likely to give any indication of errors due to other harmonics unless they were very pronounced. Hence the method must be used with great caution.

W. Duddell expressed the opinion that the harmonics could be investigated by tuning up the galvanometer to be in unison with them. The device by which the phase was changed without changing the current was very useful.

Mr. Rayner pointed out that the accuracy attainable depended on the sensitiveness of the Weston voltmeter employed.

Mr. Paterson, referring to the use of low resistances, said that errors might be introduced on account of their self-inductance. He thought that the discrepancies between the results given by the author's instrument and a Kelvin balance might be due to this rather than to inaccuracies of the balance.

The author, in reply, said that Mr. Campbell's criticisms dealt mainly with wave-form errors. Of course where iron cores at considerable saturation were employed the distortion of wave-shape would be considerable, but with the single exception of power measurement which should then be made with a wattmeter, he knew of no object in such cases for accurate potential difference or current measurements. For ordinary standardization of potential difference and current this difficulty did not present itself, as there was no difficulty whatever in obtaining a sufficiently closely sinusoidal wave-form, and the wave-forms of the measured and balancing potential differences were usually similar, being derived from the same source. The use of a second vibration galvanometer tuned to the third harmonic would be excellent if it was desired to measure them, but he believed that it would rarely be necessary, and there should be no difficulty in making measurements to an accuracy of 0.1 per cent with the ordinary alternators and resistances. For inductance and capacity measurements there was of course a positive advantage in an instrument which disregarded the harmonics. As to accuracy, it was true that this was limited by the dynamometer instrument, but this was fairly sensitive, as it was used at its best range, and it was doubtful whether it was possible under ordinary circumstances to make alternate-current measurements to within an accuracy of a few parts in ten thousand, owing to variation in the alternator speed or electromotive force.

Electric Trackless Trolley Omnibuses in Vienna and Other European Cities.

The accompanying illustrations show the equipment and method of operation of the new Mercedes-Stoll electric trackless trolley traction equipment, the current being taken from the overhead positive wire and returned to the negative wire by means of flexible cables and not by a pole, an overrunning current collector being used instead of an underrunning wheel. This collector or head consists of a frame having two small grooved wheels on each side of it, the positive wire supporting one of these pairs of wheels while the other pair runs on the negative wire, the cable being suspended from the centre of the frame, from which point there is also suspended a weighted pendulum for keeping the wheels down in contact with the trolley wires.

It is stated that the trolley runs with little or no sparking, the wheels running on ball-bearings and the pull of the cable acting upon a very short lever arm. The centre of gravity of the collector is very low, so that there is no deviation of the trolley in spite of strong transversal pull, the conducting cable being lengthened by two devices, so as to follow the car. There is an upper sliding knot tied up on the pendulum weight, as shown in the illustration, and stretched by means of a spring from the latter. There is also provided a cable roller with thirty or forty feet of cable, which is let out or rolled up by means of a spiral spring.

By means of these two appliances the car is allowed to run on the whole width of the roadway, to turn out in overtaking or meeting automobiles or other vehicles and to accommodate itself to every form of traffic. When two trackless trolley cars meet the motormen simply interchange the trolley cables by detachable contact boxes, this being a decided advantage over a single-track electric railway on which much time is lost in waiting at passing points.

Pressed steel is used on the chassis of the vehicles, which weigh about 3,750 pounds each. The brakes act on the back wheels and there are provided two motors which form a part of the driving wheels themselves. The motors are of twenty horsepower each and are mounted on the driving wheels on the Lohner-Porsche system, so that there are no mechanical parts required for control or transmission with their accompanying losses.

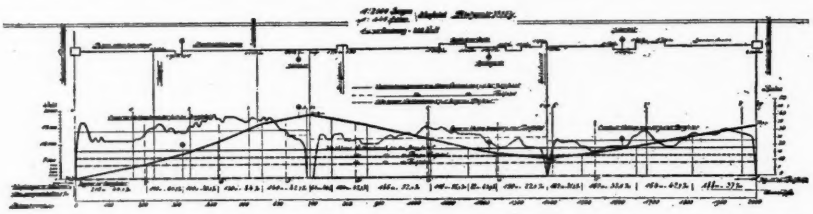
It is said that very little lubrication is required, as all parts of the motors and wheels run on ball-bearings. The cable transmitting the current passes through the axle and the armature of the motor is fixed on the axle itself by means of keys. The remainder of the wheel is mounted on ball-bearings as an ordinary motor and entirely enclosed and protected from dust, the cover hermetically sealing the motor as well as serving to fasten it on the axle.

The cost of running the trackless cars in Vienna seventy-five miles each daily is from seven to nine cents per mile, the line having a length of 1.4 miles. The current for the day's run costs forty to sixty cents at one cent per kilowatt-hour. The tires with total load of 4.2 tons cost $1.50 to $2, wages $1.80 for driver only, with taxes, repairs and garage, bringing the total running cost to from $5.20 to $6.80.

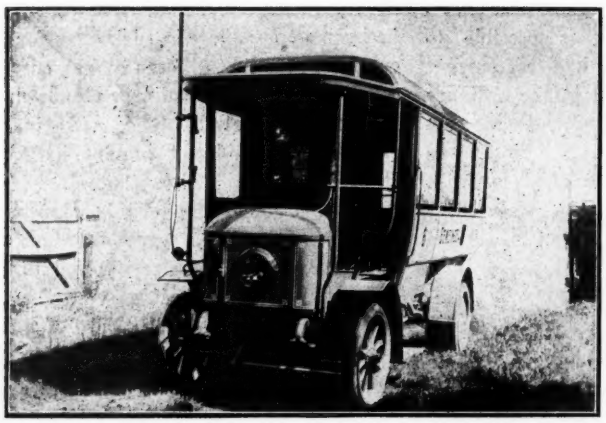
The Vienna line passes through narrow streets and around sharp corners on grades of ten per cent for a long distance. The negative pole is connected to the Vienna city electric tracks and the positive pole of the trackless trolley to the city conduit conductors. There are four cars each carrying twenty-four passengers, loops being arranged so that the cars run around continuously.

It is maintained that this system possessed many advantages, both financial and mechanical, as compared with electric storage-battery cars or buses as well as gasoline or oil-motor omnibuses. The Salford Corporation of England and the Gateshead & District Tramway Company have applied for parliamentary powers to construct new electric tramways and to provide and run omnibuses, carriages or motor cars on the trolley system without rails. This would tend to show that the recently developed electric trackless trolley systems of traction in Germany, Italy and other Continental countries have demonstrated their usefulness.

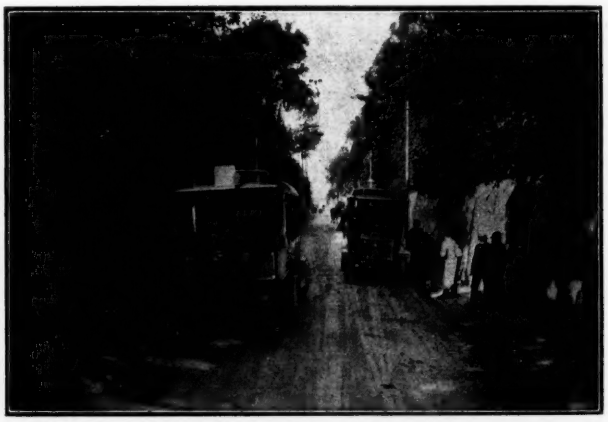
The new Mercedes-Stoll trackless trolley in operation at Vienna in connection



PROFILE AND WATT-CONSUMPTION CURVE OF POTZLEINSDORF-SALMANNSDORF TRACKLESS TROLLEY LINE.



VIENNA TRACKLESS TROLLEY OMNIBUS, OPERATED BY THE MUNICIPAL TRAMWAYS.



ELECTRIC TRACKLESS TROLLEY OMNIBUS ON TEN PER CENT GRADE IN A VIENNA STREET.

with the municipal tramway has just been started, while the Pressburg line in Hungary has a total length of 3.6 miles and will be ready in May, 1909. It will be equipped with four conductors, one freight wagon and six trackless trolley omnibuses, the total cost of the line being about one-third million crowns.

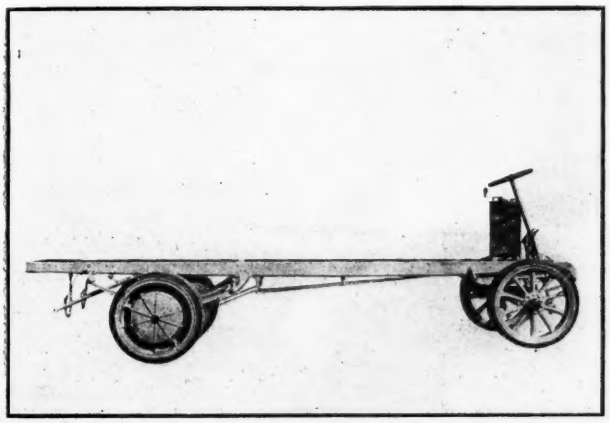
This trackless trolley system, as well as that at Weidling, near Vienna, in the Potzleinsdorf-Salmannsdorf district, also the one in operation at Gmund in Lower Austria, and at Budweis, is the invention of Ludwig Stoll of Vienna. Among the strong claims made for the system are its simple, rapid, silent and smooth running, its freedom from breakdowns and interruptions of service, economy of operation, and lightness of the omnibuses used on account of the motors forming parts of the traction wheels of the cars.

At Weidling, near Vienna, the Stoll trackless trolley road is 2.3 miles long, with a steep gradient of seven per cent and a very tortuous hilly line. There are five trackless trolley cars or omnibuses in service, each carrying twenty-one passengers. About 100 miles are run daily from five o'clock in the morning until midnight. With three cars running 2,700 passengers are carried without difficulty. On Sundays non-stop runs are possible, only ten seconds being required for interchanging the trolley cables at the meeting of the cars, this being done at any point on the line.

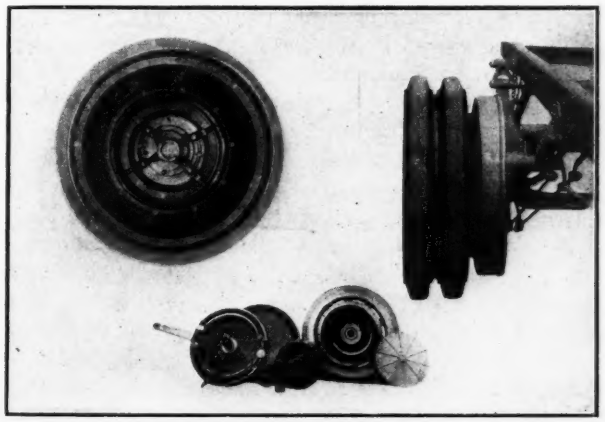
Solid tires are used on these omnibuses and electric brakes as well as mechanical brakes are provided with pedal as well as hand control. It is maintained that the two twenty-horsepower motors on these trolley omnibuses may be overloaded to double their output in emergencies without getting dangerously hot. The cars weigh 2.5 tons each; this small weight compared with the load carried is of great importance in relation to road surface wear, rubber tire wear and consumption of current.

There is a passenger and postal electric trackless trolley service running between the railway station and the town of Gmund in Lower Austria, which is under municipal control. The trackless omnibus operates from 5 a. m. to 10 p. m., making from thirty to fifty trips per day, and this single car has carried about 45,000 passengers and over a thousand packages, covering a distance of 9,910 miles without a single repair. It is stated that the motors of this car have been operated for a period of over sixteen months without any breakdown or interruption of the service. About sixty miles per day are covered, the motors being very commonly overloaded.

Including the lighting of the car and the garage and operating the omnibus, the total consumption of current for the 9,900 miles travel was 3,030 kilowatt-car-mile or 105 watts per ton-mile on an car-mile or 108 watts per ton-mile on an average. The trackless trolley line at Gmund has gradients of from one to two per cent the entire length and a maximum grade of four per cent for a short distance. The cost of operation is exceedingly low on this line, all of the expenses, including current for six months, being less than $600 per car. The cost of maintenance is said to have been $90, oil and grease $5 and current $190. The receipts of the line amounted to somewhat over double the cost of operation.



ELECTRIC TRACKLESS CHASSIS, WEIGHING 3,740 POUNDS.



MOTOR OR DRIVING WHEEL OF STOLL TRACKLESS TROLLEY OMNIBUS.

Hudson-Fulton Fund.

The sum of $250,000 has been voted by the New York City Board of Estimate as the city's part in the Hudson-Fulton celebration expenses.

New Electric Welding Process.

A new system for electrically welding rail joints has been introduced in Great Britain, and is described in a recent number of *Engineering*, from which the following is abstracted: The system adopted is very similar to the "Thomson process" of electric welding, combined with the process of fusion welding, and rails by this method can be welded together in position on the road. The adjacent ends of the rails are placed in position, and around the ends is placed a steel box in which a composition is rammed, as in a foundry box. Over the top of the joint between the two rails is placed a piece of copper which is covered entirely with the composition. On each side of the box the rails are held by a pair of heavy copper clamps. Each pair of these clamps form one terminal of the secondary winding of a transformer, the winding being formed of one massive turn of copper. The switch is placed in the primary circuit, and an alternating current is necessary for the work. When the switch is closed a strong current is caused to flow across the welding points, which are thereby raised to white heat, but the current can be regulated to give any desired degree of temperature. The time required to make the weld is from fifteen to twenty-five minutes. It is said that the gas formed by heating the composition, together with the temperature at the joint, causes the copper to run into a liquid state, and to penetrate between the two rails and form the weld in a similar way to that previously described. The joint is said to be a true weld, and not merely adhesion. The heating apparatus is suspended over the rails by means of a crane, which runs on the track. This system is controlled by Mr. J. Lord, Globe Works, Thorp Street, Birmingham, Eng.

INCREASING THE POPULARITY OF ELECTRIC VEHICLES.

FRANK B. RAE.

A recent article in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, stating that an association has been formed in New England for the purposes of promoting the use and increasing the popularity of electric vehicles, and the editorial comments in connection therewith, are both timely and valuable. This and other associations of a like character throughout the country would tend to rapidly increase the introduction of electrically driven cars and also to eliminate, or at least materially decrease, the tendency upon the part of garage owners and the automobile agencies to minimize the usefulness of the electric vehicle. Associations such as these would, in a short time, bring about many needed reforms in the matter of garage service, particularly in the care of batteries; in recommending certain standards to be adopted in the matter of battery equipment for cars; endeavoring to secure better satisfaction to the owners of electric cars by the substitution of the watt-hour rate for the flat-rate, and generally to educate the owner to at least a fair working knowledge of his machine, its capabilities and limitations.

In addition to such help as an association could give in the matter of battery care and repairs, it should suggest that the vehicle manufacturers adopt a standard battery; not as to its type or make, but with respect to the number of cells, or voltage-standard of the battery employed.

At present electric cars are equipped with twenty-four, thirty-two, forty or forty-four cells, adapted to the particular idea of voltage that the designer of the motor happened to have. In each case, however, the battery has necessarily the same watt-hour capacity, and the weight is practically the same. There is, it is true, some slight advantage in the first cost to the vehicle manufacturer in furnishing a battery consisting of one of the smaller number of cells of large capacity, and a small gain to the vehicle owner in cost of plates for renewals; but the higher voltage of the larger number of cells, as affecting the action of the current in the operation of the car, and the final yearly cost, for current, renewals and repairs, should govern the selection in favor of the larger battery, and forty cells might be fixed upon and advised as the best number to use.

It may be stated quite safely that the larger number of garages are supplied with direct current at an average pressure of 115 volts, and therefore the difference between the volts at the charging mains and the counter electromotive force of the battery when being charged must be absorbed by a rheostat. The lower the voltage of the battery the greater is the loss in the rheostat, and it is obvious that the owner of an electric vehicle with the low-voltage battery is getting the worst of it.

This becomes clear by taking as an illustration, two cars, one equipped with, say, twenty-four cells, and the other with forty cells, and assuming that their capacity in watt-hours is the same. In the first case the counter electromotive force, plus drop due to internal resistance during charge, is approximately 57.5 volts; in the second case it is 95.6 volts. In charging these cells from the direct-current mains at 115 volts, there must be inserted in the circuit with the twenty-four cells a rheostat to absorb the difference, or 57.4 volts; with the forty cells the rheostat absorbs but 18.4 volts.

Taking the watt-hours of charge in each case to be the same, say 9,000 watt-hours, and the charging currents thirty-five and twenty-one amperes, respectively, the total watt-hours per charge taken from the mains for the twenty-four cells are about 20,250, of which the rheostat dissipates 11,250 watt-hours, or fifty-five per cent. The forty cells, however, will take from the mains only 12,180 watt-hours, of which 3,180 watt-hours are lost in the rheostat, or 24.6 per cent. In the first case the efficiency of charge is forty-four per cent, and in the second case seventy-four per cent. At five cents per kilowatt-hour it will cost the owner of the twenty-four-cell car $1.02 each time his battery is charged, and the owner of the forty-cell battery only $0.61. Or, to state it differently, the kilowatt-hour rate becomes 11.6 cents for charging the twenty-four-cell battery and 6.75 cents for the forty-cell battery, under the assumptions as stated before.

The garage flat-rate basis of charge, however, makes the cost to each owner the same, whatever number of cells he may have in his car, which is not only unfair to the owner of the forty-cell car, but under conditions that are very probable will work out unfairly to the garage man.

Assume again that both cars taken as an illustration are of the same weight and make the same mileage per year, say 8,000 miles, and for this total run that they have been charged 140 times. Then the twenty-four-cell car has taken from the mains 2,834 kilowatt-hours at five cents, producing a revenue of $141.70, and the forty-cell car 1,995 kilowatt-hours at five cents, or $99.75. Adding the usual garage charge for storage, washing, etc., of $144 per year, we have in the first case $141.70 + $144 = $285.70, and in the second case $99.75 + $144 = $243.75 as the cost to the garage per car per year.

If fifteen per cent is a fair margin of profit to the garage proprietor, which he includes in the usual total flat-rate charge of $300 per car per year, then he should realize from the two cars a profit of $45 each or $90; whereas, as shown above, he gets a profit of only $14.30 from the twenty-four-cell car, which is only 4.75 per cent. The forty-cell car, however, pays a profit of $56.25, which is over eighteen per cent.

If all the cars made the average mileage assumed, a garage full of twenty-four-cell machines would ultimately ruin the garage man. That it does not now operate to do so is because he trades upon the ignorance of the owners. The flat-rate is the same for the owner that drives his car the 8,000 miles as it is for the one that finds it necessary or desirable to go only 800, and this difference in mileage, looked after in charging the battery, evens up the percentage of profit.

The flat-rate system of charging is all wrong and undoubtedly works harm to the electric automobile industry, affecting both the manufacturers and central-station operators as well as the garage. It is clearly within the province of an association of these several industries to correct this.

The owner should pay for current supplied to his battery as he does for any other application of central-station energy at some fair rate per kilowatt-hour, and this rate should pay the garage a profit. Each charging station in the garage should be equipped with a dial-recording ammeter and the owner should have a daily record of the energy he obtains.

A flat-rate garage charge that includes current for running the car whatever number of miles the owner may desire to travel is about as consistent as such a rate would be for the owner of a gasoline car in which the flat-rate included gasoline. This owner buys his energy in the form of gasoline by the gallon poured into the storage tank of his machine through a funnel at so much per gallon. The electric-car owner, however, must have his

energy poured into his storage tanks through a wire, but it may be measured quite as accurately as the gasoline, and he should know, as the gasoline-car owner knows, how many gallons, or watts, or whatever the unit of measurement may be called, he is paying for.

By urging upon the manufacturers of electric cars a standard equipment of forty cells per car, as being best adapted to the voltages of central stations, the greatest economy to the owner in energy per mile of travel is secured. When this is understood by the owners, as it must be, eventually, the owner of the car equipped with the smaller number of cells will surely demand the change; moreover, he will decline to recommend a car to a prospective buyer that is equipped with less than forty cells, because he knows what it means in yearly cost to operate a car with any lower number.

Why not anticipate this? Put all of the owners upon the same basis in the matter of battery voltage, force the garage to furnish energy in measured quantity, and obtain a car-mile cost for comparison of the various makes of cars which will further progress the electric vehicle in design, construction and public use.

Electrical Exports for February.

The total electrical exports from the United States during February showed improvement compared with the preceding month. As compared with the corresponding month of last year, however, there was a marked falling off. This was no doubt due to the exceptionally large exportation of electrical machinery during February, 1908, and to that month having had an additional business day.

As prepared by the Department of Commerce and Labor, the official statistics are as follows:

	Feb., '09.	Jan., '09.	Feb., '08.
Appliances	$ 462,856	$500,309	$ 479,779
Machinery	598,736	452,851	844,047
Total	$1,061,592	$953,160	$1,323,826

The principal countries to which electrical products were exported during February, 1909, and the value of the exports were as follows:

Exported to—	Electrical—Appliances.	Electrical—Machinery.
United Kingdom	$ 43,362	$ 49,088
Belgium	8,008	.....
France	3,689	7,824
Germany	9,676	589
Other Europe	13,542	49,423
British North America	127,609	36,603
Central American States and British Honduras	20,136	180,962
Mexico	45,137	47,267
Cuba	29,915	26,056
Other West Indies and Bermuda	6,732	2,938
Argentina	10,628	6,630
Brazil	58,369	125,287
Other South America	18,889	2,018
Japan	14,133	28,303
British Australasia	12,678	14,799
Philippine Islands	31,647	3,213

ABUSES OF STORAGE BATTERIES IN ELECTRIC VEHICLE WORK.

BY WALTER L. THOMPSON.

The electric vehicle storage battery, a device which came into use in connection with the earliest forms of motor vehicles, has probably received a greater amount of vilification and abuse (both oral and mechanical) than any other feature of the self-propelled vehicle, and due regard for truth compels us to admit that in its early history this too often has been well deserved.

The problems involved in the production of a satisfactory storage battery for motor vehicle purposes were by no means solved in the earlier forms, and the result has been a tremendous amount of dissatisfaction, out of which has grown a strong prejudice in the public mind, which is by no means justified by present conditions. Many disgruntled users were even disposed to deny that there could ever be any improvement in the storage battery.

About this time the manufacturers of storage batteries awoke to the fact that a special type of battery was needed to meet the severe demands and conditions incident to motor vehicle service. What has been accomplished along this line may best be illustrated when it is stated that the battery of today of a given capacity is fifty per cent lighter than the representative earlier types, and occupies much less space. The modern type of battery occupying a given space will deliver an output sixty-five per cent greater than that of earlier types of cell. A successful make of cell now on the market has shown that an output of five ampere-hours per pound of cell is both safe and dependable.

Experience has enabled the manufacturer to know how far he can go in the matter of reducing weight without incurring a corresponding loss in some other direction. Various designs of grids are now in use, each having its distinctive features, and possessing more or less individual merit. Suffice it to say that the best types now known have successfully met the various problems presented in electric vehicle service, not only as to weight, capacity and life, but as to the highly important matter of economy as well.

Notwithstanding the importance of all the improved features already noted, the degree of satisfaction which the user of the electric vehicle is to experience depends almost wholly upon the treatment accorded the battery in actual service. Since the inception of the electric vehicle the storage battery has been outrageously abused and it has seldom had the chance to show the full amount of work it is capable of doing under proper conditions. A very large proportion of troubles experienced in storage batteries may be attributed to the mishandling of batteries as the result of ignorance. Also troubles frequently result from willful neglect, the remedy for which is not always within easy reach of the manufacturer. It is clearly the duty of the manufacturer, however, to provide users of his product with complete instructions relative to the care of their batteries, and to co-operate with them so far as possible to insure a proper application of these instructions. Happily this is now being done and the results have been most gratifying.

Following are enumerated the principal forms of abuse to which storage batteries in vehicle service are subjected:

Not maintaining the acid at proper specific gravity.

Unnecessary addition of acid when replenishing or flushing cells.

Allowing battery to stand for hours in an exhausted condition.

Habitual undercharging.

Charging too frequently.

Continuing battery in service when in need of cleaning.

Charging at too rapid a rate.

High temperature.

Overcharging.

Over discharging.

Neglecting to replace leaky jars promptly.

Not flushing battery regularly; allowing level of electrolyte to fall below tops of plates.

Neglecting inactive cells.

Use of impure acid; allowing dirt or any foreign matter to get into the cells.

Failure to keep terminals and connections cleaned and tight.

The specific gravities variously prescribed by manufacturers for electrolyte of vehicle cells, ranges from 1.275 to 1.300 when the battery is in a fully charged state. Since a definite amount of acid is utilized out of the solution for a certain number of ampere-hours discharged by the plates, it is obvious that the solution must be of sufficient density at the beginning of the discharge to insure a full normal discharge which will not be limited by the amount of acid in the solution. In practice it is a good plan to maintain the density at such a point that it will not fall lower than 1.175 at the completion of a normal discharge. It is exceedingly injurious to the plates to allow the density of the electrolyte to rise

above 1.300. Excessive sulphating then ensues and deterioration is augmented. It is not a difficult matter to keep the density of the electrolyte within proper bounds, and it requires very little time if undertaken systematically.

Oftentimes acid is added to the cells with the mistaken belief that this is needed to bring the specific gravity of the electrolyte to the proper degree. In truth, the previous deficiency in the gravity might have been due to the fact that some of the acid had left the solution and entered into combination with the material of the plates, producing sulphate, this having resulted from improper treatment. The correct remedy in such a case would be to give the battery a charge of sufficient duration to reduce this sulphate and restore the sulphate back to the solution. When the battery gets in this condition, the addition of acid is not only unnecessary but it serves to aggravate the trouble which develops when the plates become sulphated. Recently, one of my customers claimed that the performance of his battery was very unsatisfactory, and upon investigating the matter, I discovered that the gravity of the electrolyte was rather low. He stated that he had noticed a tendency of the gravity to fall off, and, accordingly, had made frequent additions of acid. The cell covers being sealed, there was nothing to explain the apparent loss of acid except sulphatation, and this conclusion was confirmed when I learned that his method of charging had been very haphazard, and that on a number of occasions he had allowed the solution to get so low in the cells that the plates were exposed to the air. Upon giving this battery a protracted charge at a low rate, the gravity gradually rose to a maximum point of 1.370, indicating that there had been a tremendous amount of sulphate in the plates, induced by the improper treatment the battery had received, and this was now converted back into acid. It is needless to say that after this attention there was a very decided improvement in the condition of the plates and in the performance of the battery.

A frequent cause of sulphating is the practice of allowing batteries to stand for hours in an exhausted condition before recharging. Every time this occurs excessive sulphating takes place and the following charge should be prolonged sufficiently to reduce the sulphate. The presence of sulphate in battery plates in too abundant quantities will very seriously affect the efficiency and capacity of the battery and it promotes disintegration of the active material. One of the chief causes of sulphating of plates is insufficient charging. If a practice is made of undercharging, sulphate will accumulate in the plates in increasing quantities.

The practice of giving batteries short charges between trips, regardless of the amount of energy still remaining, is pernicious, as it results in unnecessary depreciation of the plates, and no good purpose is served in so doing. The life of a storage battery is determined largely by the number of charges it receives. If one-half or less of the mileage capacity of the battery has been utilized during the day, it is preferable to make use of the remaining mileage the next day, before recharging, rather than to recharge after a partial discharge only.

When the sediment in the cells, resulting from the shedding of the active material, accumulates to the point where it comes in contact with the bottoms of the plates, a path is thus provided for leakage of current, local action takes place in the plates, and the capacity of the battery is greatly reduced. Continuing to operate the battery while in this condition will cause permanent injury to both positive and negative plates.

In the desire to economize time in the recharging of a battery, there is a strong temptation to employ too high a charging rate, but it is wise to follow explicitly the manufacturer's instructions in respect to the charging rates. In case there is urgent need of haste in recharging, a moderately high rate may be permissible during the earlier part of the charge, but never during the final stages.

No good is accomplished in continuing the current when the battery is fully charged; on the contrary, it causes a loosening of the active material in the plates, and so hastens deterioration. It also tends to raise the temperature to an injurious degree. The temperature should never be allowed to exceed 100 degrees Fahrenheit, as an increase beyond this point is likely to result in disintegration of the active material.

While it is true that a battery, after having reached the limit of its normal discharge, possesses a limited power of recuperation, it is unwise to utilize this secondary accumulation of energy, as overdischarging subjects the weaker cells in the battery to undue hardship and promotes sulphatation.

If a leak develops in a cell and the plates are thereby partially or wholly exposed to the air, it is not sufficient to replace the plates in a new jar, cover them with electrolyte, and restore the cell to its place in the battery; before returning it to the battery it should receive an individual charge until normal conditions as to gravity and voltage have been restored.

Permitting the solution to fall below the tops of the plates reduces the effective area of the plates, besides rendering the exposed portion liable to disintegration.

Inactive cells usually result from internal short-circuits, and when permitted to remain unattended, greatly reduce the efficiency of the battery.

It is, of course, clear to almost everyone that the use of impure acid or allowing dirt or foreign matter to get into the cells, is liable to work great harm to the plates. Notwithstanding this, vehicle owners are very careless in this respect and especially is this true with electric trucks. Incidents are on record where beer, lime and coal which was being hauled by trucks, got into the batteries and created havoc.

Broken connections and loose terminals not infrequently cause entire stoppage of the vehicle and the necessity of keeping them in shape is too apparent to dwell upon it here.

It is obvious to the experienced electrician that these various abuses have been dealt with only in a superficial manner, as the present available space forbids any extended treatment on the subject, but it must not be understood that they are difficult to avoid. As a matter of fact, the proper maintenance of a storage battery is but little more than routine, does not require a high degree of intelligence and the results of faithful attendance fully justify the moderate amount of time expended.

Electric Drive in English Cotton Mills.

In a recent paper read before the Liverpool (England) Engineering Society some interesting particulars were given of the application of electricity in the manufacture of yarn and cloth. A single-phase repulsion motor for driving a ring-spinning machine allowed maximum speeds to be obtained by permitting the speed variation necessary to equalize the tension on the yarn. Mr. W. Hoult, the author of the paper, recommended that mules should be electrically driven in groups of six, and looms by a small three-phase motor to each. With the exception of mules, and possibly also of carding engines, individual driving was recommended for all cotton machinery.

CENTRAL STATIONS AND THE ELECTRIC AUTOMOBILE.

OPINIONS OF LEADING CENTRAL STATION MEN AND SOME OF THE RESULTS THAT HAVE BEEN SECURED.

In connection with the impetus which has recently been given to the discussion of the relation of central stations to the automobile business, it is interesting to note the attitude which has been adopted in several of our largest cities and the success which has resulted from the attention which has been paid to the building up of a profitable line of business in the charging of automobile storage batteries. Some interesting data follow:

ROCHESTER RAILWAY AND LIGHT COMPANY.
J. T. HUTCHINGS.

The Rochester (N. Y.) Railway and Light Company increased its income from storage battery, charging thirteen-and-one-third per cent last year. With this company the charging of batteries for electric automobiles is quite an important item, its income last year being approximately $30,000. The company has given close attention to this part of the business and it has learned that there have been many vehicles which were not used as they should be and that a great deal of unsatisfactory operation has been occasioned through mechanical defects and to neglect of the mechanical parts of the machine. There has also been in many cases a total neglect of proper attention to the battery itself.

The company has recently established a department under the direction of C. D. Hibler, who for fifteen years was connected with the Electric Storage Battery Company and for a number of years in charge of that company's maintenance and construction work in northern New York.

The establishment of this department under expert supervision revealed the fact that conditions were far worse than had been assumed from previous investigations. A number of cases were found where customers had purchased new electric runabouts, becoming very enthusiastic over them for the first two or three months, after which their enthusiasm died away. It was evident that there had been a great disappointment. Upon a careful investigation of all the facts it was found that during all the time the vehicle was in use no inspection whatever had been made of the battery, and the electrolyte had been allowed to evaporate to such an extent that only a few inches remained in the bottom of the cell, commutators were excessively dirty, brushes were out of alignment, and the machine was in a generally defective condition mechanically.

The new department will instruct the customer how to handle his machine and a close watch will be kept on the work of all charging stations and repair shops in the city, with a premium in more business to those which are doing honest and satisfactory work. A log book will be kept for each vehicle showing the date that the battery was purchased, miles operated and if possible the amount of current consumed. A regular inspection will be made to ascertain the exact condition of the batteries.

ROCKFORD ELECTRIC COMPANY.
F. H. GOLDING.

The Rockford Electric Company of Rockford, Ill., inaugurated an automobile campaign in 1904. At that time there were only one or two electric vehicles in the city. The company fitted up a charging station and repair shop in connection with its storage-battery plant, the battery attendant looking after the vehicle charging. A rate was fixed at six cents per kilowatt-hour, with a minimum charge of $1 per month. It was understood by the owner of the automobile that he would not charge his batteries between the hours of 4 p. m. and 9 p. m. during the months of November, December, January, February and March. Today, with 50,000 population, there are over 130 electric vehicles in daily use in the city. There are six public garages where electric vehicles are charged and cared for, and fifty-five vehicle owners who have charging plants in their private garages.

The fifty-five private garages have paid the company at the rate of $45.50 per year each, and the average yearly revenue from all the electrics in use will approximate about $60 each.

The central station rate for public charging is six cents net for "off-peak" service and the public garages offer a rate of $24 per month for twenty-four-cell vehicles, which includes battery charging, washing, delivery and ordinary general attention. This rate does not include tire repairs, extraordinary electric repairs or battery washing and renewals.

The greater number of private plants are on direct-current system, but there are also a number of motor-generators on alternating current, and these are increasing, the advent of the mercury rectifier facilitating the utilization of alternating current.

BROOKLYN EDISON COMPANY.
W. W. FREEMAN.

The Edison Electric Illuminating Company of Brooklyn, N. Y., is co-operating with the manufacturers and selling agents in the development of the electric automobile business in this territory. The introduction of the electric pleasure vehicle in Brooklyn has been somewhat retarded in past years by the condition of the streets, and due also to the fact that the points of interest adjacent to this city have been more or less beyond the range of travel in an electric automobile. With the improvement of the vehicle battery to meet long-distance requirements and the great improvement which is taking place in the city due to repaving and the linking together of the boulevard systems, the company is sanguine of this portion of the business assuming large proportions.

PHILADELPHIA ELECTRIC COMPANY.
W. C. L. EGLIN.

The Philadelphia Electric Company, Philadelphia, Pa., has introduced a rate of six cents per kilowatt-hour, subject to a minimum of $5 per charging set per month, the restrictions being that the owner may not charge the batteries between the hours of 4 and 7 p. m. during the period between October 15 and March 15.

The customer who has his own garage and charging set and who is using electric light in his house need not have a separate meter and may earn as low a rate as six-and-two-thirds cents per kilowatt-hour, without restrictions as to hours of charging, and with a further advantage that this rate also applies to his use of electricity for lighting. At these rates the ordinary monthly charge for operating automobiles will average less than $2.

Public garages are located in all portions of the city and these will take care of the electric car, keep it in good condition, call for it at night and deliver it in the morning at a cost varying from $35 to $45 per month.

The company supplies direct current and alternating current for automobile charging purposes, the former being supplied in a very small part of the city and the latter over practically the entire city, excluding the direct-current district.

In the alternating-current district it is, of course, necessary to introduce mercury arc rectifiers or motor-generator sets, and

the former are giving satisfaction, both from the maintenance and efficiency standpoints.

The capacity of the rectifiers necessary for this class of work varies from twenty to forty amperes and of the nineteen selected consumers having private garages the average kilowatt-hours per month is 186.

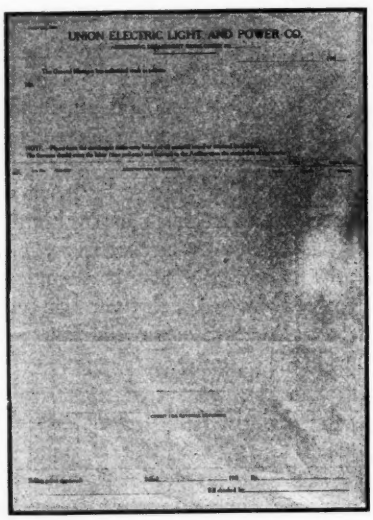
On several occasions representatives of the company have met with the manufacturers or their agents and have discussed the relation of this business to the central station, assisting them in every way possible to make the sale of an automobile and, therefore, a new consumer or an old consumer using more current.

DENVER GAS AND ELECTRIC COMPANY.
R. B. MATEER.

The Denver Gas and Electric Company has established the most cordial relations with the owners of public garages and those operating and owning private garages; each is a booster for the others.

Denver has more automobiles than any other city of equal population in the United States. A large percentage of the total number of machines are electrics of various standard types. Electric machines require recharging and two alternatives are available to the owner of such a machine, viz.: To install a rectifier and charge the machine under his own supervision, or to leave the charging of the machine to the public garage.

have equipped them with mercury arc rectifiers. The desire to have the machine always within easy reach, the apparent increased life of the battery, the small cost for current consumed in charging the



WORK RECORD.

car and the apparent independence have resulted in many rectifiers being installed in residence sections.

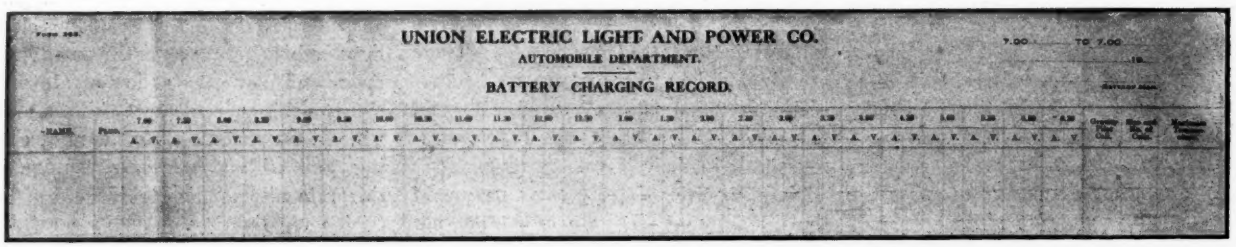
UNION ELECTRIC LIGHT AND POWER COMPANY.
C. E. MICHEL.

The Union Electric Light and Power Company, St. Louis, Mo., began its campaign for automobile business about three years ago. Due to the poor service rendered to users of electric vehicles, there were but seventeen cars on the streets of St. Louis at that time. The company built and equipped a first-class garage and installed modern appurtenances of every description. The switchboard of this garage enables the company to charge sixty-two machines at the same time, each on its own individual circuit. The board is arranged with a separate rheostat for each circuit and is equipped with volt-ammeters and double-throw switches, enabling the operator to read the battery on each of the different machines he is charging without leaving his station at the board. The garage was placed in the hands of competent electricians and the agency for three electric vehicles was accepted by the company, the machines of the Rauch & Lang, Studebaker and the Columbia companies being selected.

Since the company opened this garage and demonstrated to the people of St. Louis what a first-class institution of this kind could do, the number of electric vehicles has increased to over 300. A very satisfactory number of sales have been made and in addition to the companies whose agencies were accepted by the Union company the manufacturers of the Wood, Pope-Waverly, Columbus, Detroit, Baker and Babcock electric cars have established agencies in St. Louis.

The garage is maintained for the benefit of all the owners and makers of electric vehicles. It is a fact that for a good part of the past year all of the companies having agencies in the city have kept demonstration cars in this garage.

In addition to its public garage, the company gives its supervision to electric cars, which are kept in the private garages of their owners and charged through mercury arc rectifiers. The company suggests the use of these rectifiers, providing the owners of the cars turn the cars over to the electric company once in every two weeks for charging, so that careful watch can be kept on the condition of the battery.



BATTERY-CHARGING RECORD.

Denver has many garages devoted to electric machines, all of which seem to be prospering, due doubtless to a combination of the following facts:

(*a*) The large number of electric machines in the city.

(*b*) The use of very efficient charging outfits, which are principally the forty-ampere garage panel and the thirty-ampere rectifier.

(*c*) The rates offered by the central station are exceptionally desirable and encourage an increase in business.

Many owners of cars have erected upon their own property very neat garages and

The company maintains an elaborate and thorough record of inspection, consisting of thirty-minute readings on every car on charge; temperature readings at stated intervals; pilot-cell and specific gravity readings on every battery every night; and individual cell, volt and gravity readings on every battery in the garage at periods not greater than each seven days. These records are supplemented by numerous others which may be found expedient.

Three years ago the company started with eleven machines in its garage. Today the company has under its direct su-

pervision seventy-four machines and is taxed to the utmost to take care of its present business in spite of the fact that within the past two months the capacity has been increased twenty per cent. Plans are now being formulated for the extension of this business.

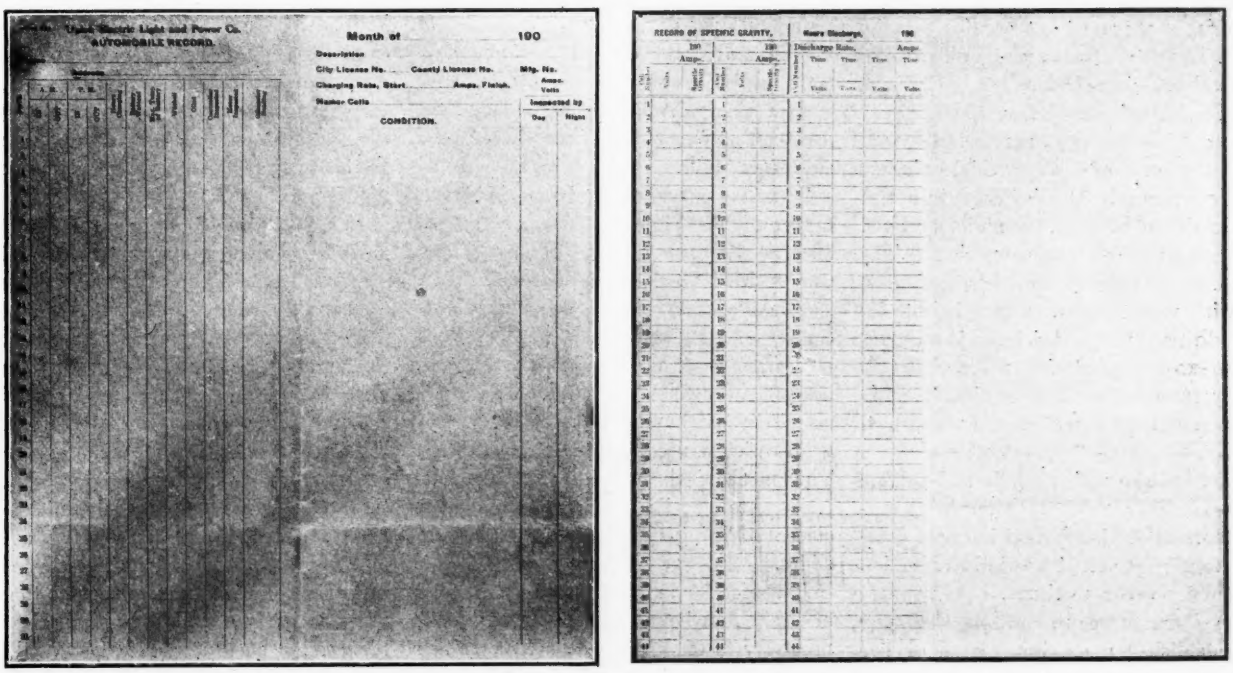
It is expected that a large number of electric vehicles will be sold in St. Louis during the next twelve months. The company has under order with one of its factories seven electric cars to be delivered within the next three weeks. Since they were ordered two weeks ago all but one of these cars have been sold.

COMMONWEALTH EDISON COMPANY.
ERNEST LUNN.

The Commonwealth Edison Company has been one of the most consistent and successful users of electric automobiles in Chicago. For the past eight years its supply department has made use of from nine to fifteen commercial electric trucks. They have been used principally for hauling supplies from depots, delivering goods to customers, and doing emergency and other duties incident to the company's business.

The trucks have sufficient capacity to enable them to be driven from forty to sixty miles daily, and at a speed as high as is consistent with safe driving. The behavior of these trucks has been watched and records of the cost of operation have been carefully kept in order that statistical records would eventually show whether the electrically driven vehicles could be expected to compete with other forms of street-traffic propulsion. Results have been exceedingly gratifying, and the Edison company believes implicitly in the electric vehicle. At the time the trucks were first put into use there was considerable doubt in the minds of many as to their practicability for general hauling, owing to what was feared would be high maintenance costs, and inadequate daily mileage. Their simplicity, however, appealed to many, and was a strong factor in their favor. As was predicted, the maintenance costs of the early types of vehicles were high, and the mileage on a single battery charge was insufficient, but with use came better knowledge as to what was required of the trucks, and what was needed in the way of reconstruction to lessen the one factor and increase the other. In this respect the development of the electric vehicle is like that of nearly all machines. Improvements and a better understanding of its use, often turn failure into success. Improvements in design have reduced maintenance cost, particularly that of driving mechanism, to a degree where it may be considered of secondary importance. With improvements in driving mechanism there have also come improvements in battery construction, so that the early predictions as to excessive maintenance cost, and low mileage, while true for a time, have now been disproven.

The practicability of operating electric commercial vehicles in Chicago, judging from the Edison company's experience, while dependent to some extent upon conditions governing individual cases, has, in the main, been conclusively demonstrated, and, as a result of their successful use, the Commonwealth Edison Company is adding vehicles of the same type to its equipment. This fact should encourage others to consider seriously the adoption of the electric vehicle where possible. Realizing that certain success will be the ultimate outcome of the electric-vehicle industry, the Edison company has adopted a policy of aiding in every way consistent the efforts of the vehicle manufacturer in fostering its growth in Chicago. It has established charging stations throughout the city at its various substations, in order to facilitate the recharging of batteries. It has made a rate of charge for current supplied to public garages and charging stations of five cents per kilowatt-hour maximum, with a sliding scale downward, dependent upon the amount of electrical energy used, and is encouraging in every way the introduction of private charging plants, and the use of the mercury arc rectifier.



AUTOMOBILE RECORDS.

New Subway for Boston.

After two years' delay the city of Boston, through Mayor Wardwell, has formally accepted the plans for a new subway to be built by the Boston Elevated Railway Company from Charles River to Harvard Square.

The Relation of the Central Station to the Automobile Business.

On the evening of Wednesday, March 31, a meeting was held at Chicago, in the rooms of the Western Society of Engineers, under the auspices of the Electric Storage Battery Company of Philadelphia, Pa., for the purpose of bringing together the builders of electric vehicles, the dealer, the manufacturer of storage batteries and central station managers. The object of the meeting in its broad sense was to encourage as far as possible the more general adoption of the electric automobile for both pleasure and commercial purposes.

The meeting was opened by Godfrey H. Atkin, Chicago manager of the company, who sketched the development of the electric automobile and pointed out the great advances which have been made in electric vehicles, and in the proper utilization of propulsion storage batteries.

The first paper of the evening was by E. W. Lloyd, contract agent of the Commonwealth Edison Company, of Chicago, Ill. Mr. Lloyd stated that the territory around Chicago was particularly well suited to the use of electric vehicles. There are approximately 3,000 of these in use in the vicinity of Chicago, the majority, however, being used as pleasure vehicles. The growth of the electric truck has been slow, but with recent improvements in the design of this type of vehicle, it is reasonable to expect that its utilization will greatly increase, as it is manifestly more economical in service than horse-drawn vehicles.

The handicap which public and private garages suffered due to alternating-current systems of distribution has been overcome to a great extent by the introduction of mercury-vapor rectifiers.

The Commonwealth Edison Company has established a maximum rate of five cents per kilowatt-hour for current used for charging in public garages. A lower rate than this can be earned on the Wright demand system of charging when the conditions are favorable for long-hour service. With the maximum of fifteen kilowatts ten hours per day, the rate is as low as three-and-one-fourth cents per kilowatt-hour. Should a garage be able to charge for fifteen hours per day the rate for fifteen kilowatts demand would be under three cents per kilowatt-hour.

It seemed to Mr. Lloyd that the equitable way for charging for electric vehicle maintenance would be to have a fixed barn charge for the storage and cleaning of the machine, and a secondary charge based on the miles run per month. If this basis could not be worked out, a fixed price per complete charging could be made, but the objection to the second method is that it would not always be necessary to deliver a full charge to the machine.

If the charge for maintenance is based on a mileage basis there should be a sliding scale according to the mileage per month, the cost being reduced per mile as the mileage is increased. Short-mileage users compel the use of charging apparatus intermittently and a few hours a day. In that case the overhead costs on the plant are larger per unit than where long-hour charging per day is the rule. The basis of charging for electrical energy for their services is along this line, and it is logical because it costs the same for fixed charges per kilowatt demand for the man who uses current one hour per day as it does for the man who uses it twenty-four hours per day. For the operation of the apparatus the cost of fuel and supplies varies directly as the amount of energy required. Therefore, a long-hour user can be charged a lower price than a short-hour user.

The next paper was by Bruce Ford, engineer of the Philadelphia works of the Electric Storage Battery Company, and was entitled "The Exide Battery." Mr. Ford sketched briefly the elementary conception of a storage battery and described the earlier work of battery manufacturers, leading up to the dissertation on the characteristics of the Bradbury-Stone type of grid, which is used in the Exide batteries. The mechanical features of these batteries were described in detail, the various elements being illustrated by lantern slides.

Batteries for automobile work are rated at their four-hour discharge rate. It is necessary to qualify the capacity of a cell by the rate at which the discharge is taken, since the capacity varies with the rates of discharge, and an 11-MV cell could be called 140-ampere-hour cell or 161-ampere-hour cell, according to whether it were rated at its four-hour discharge capacity or its eight-hour discharge capacity. The lower the rate of current the higher the capacity, and, conversely, the higher the rate of current the lower the capacity in ampere-hours. At the lower rates of current the average voltage obtained during the discharge is higher, so that the watt-hour output at the different rates varies even more than the ampere-hour capacity. This point is of the highest importance in showing the necessity of keeping the automobile in the best possible condition, so that it will consume the lowest possible current. If by reason of poorly lubricated bearings or a binding brake the current consumption is increased, the capacity of the battery, or in other words, the mileage which the vehicle can make, is reduced in much greater percentage than that by which the current is increased.

Under proper service conditions the capacity of the Exide cell will increase with use. This cell is rated at its initial capacity, and as the cell is worked this capacity begins to increase, until where the initial capacity was four hours, this may be increased to from four-and-one-half to five hours at the same rate of current. This is due largely to the action of the active material on the positive plates, which with working becomes more porous and open at the surface. With use, however, this more porous surface material gradually becomes softer, and the material close to the surface becomes washed out. After a time a balance is arrived at, when the increase in capacity is neutralized by the loss of material, and at this period the capacity remains constant at its maximum value.

In a short time, however, the washing out effect becomes greater than the effect due to the opening up of the material, and the capacity gradually falls off. The falling off, however, is much slower than the rise, until the material is very much washed out, when the plate is rapidly nearing the completion of its useful life.

This characteristic of the increase in capacity with working is important, as these cells are rated at their initial capacity. If the cell were rated at its maximum capacity and its life started at the point of maximum, although the initial capacity would be considerably higher, the amount of life lost would be greater. This is the fundamental reason for rating the Exide battery on this conservative basis.

There is often some doubt in the minds of battery operators as to when a plate should be thrown away as worn out. If the thin portions of what remains of the original pencils of active material are entirely washed through in any place, the general rule may be applied that the life remaining in the plate is not enough to warrant the expense of reinstalling the same positives. If, however, the washed out portions on either side of the plate do not meet, so that there is a solid film of active material all over the plate, then in general the amount of life left in the

plate will pay for putting it back into service.

In regular operation it is best to charge at the lowest rate possible. The principal wear on the plate is caused by gassing during the charge. As this gassing is reduced by a lower rate of current, the wear on the plate is correspondingly reduced. Since gassing occurs more toward the completion of the charge, it is at this point that it is imperative to have the current lower. In order to get the necessary number of ampere-hours into a battery in a given time with the least wear, the current should be high at the beginning of the charge and low at the completion.

There is often much strong electrolyte in the cell which is not evidenced by hydrometer readings. Such a condition exists when a cell has not been sufficiently charged, either at the beginning of its life or at subsequent periods. There is a resulting accumulation of sulphate in the plates, which causes the gradual reduction of the specific gravity of the electrolyte. The cause not being understood, the gravity is brought up by the addition of stronger solution; thus the trouble is further aggravated until deficiency in capacity causes complaint. Batteries in this condition require a long time of continued charging to reduce all the sulphur.

It is rarely necessary to add anything but water to the cell between times of cleaning, and it is usually in cases where there is much splashing or where there are leaks in the cell that acid has to be added. In no case should the specific gravity of the electrolyte be allowed to become higher than 1.300 when the cell is in a state of full charge and the plates are absolutely free from sulphate.

Mr. Van Splunter, of the General Electric Company, delivered a brief extemporaneous address on the theory and application of mercury-vapor rectifiers, and a considerable part of the discussion which followed was taken up in amplifying minor points brought up by his remarks.

Mr. Rice, vice-president and general manager of the Waverley Company, called attention to the point that while it was the general impresion that the electrical vehicle was used chiefly for pleasure purposes, it was, in fact, essentially a business vehicle. All those interested should emphasize the fact that there is no conflict between the gas car and the electric. Each has its uses, and while the electric cannot compete with the gas car in some directions, the latter is the case when the electric car is used for what it was built for, and what it is intended for. Emphasis should also be laid upon the simplicity of the electric vehicle and the storage battery. It was when dealing with unfamiliar terms that the uninitiated became confused; and it is also a fact that compared with the intricacies of the gas engine, the electric equipment is decidedly simple.

Hanson Robinson, assistant general manager of the Studebaker Company, of South Bend, Ind., next addressed the meeting upon a comparison of the electric wagon and horse-drawn vehicle. Mr. Robinson stated that when all the elements which should enter into a comparison were considered, that the electric wagon would be found to be a great deal more economical, and that where street transportation was handled to any considerable extent the electric wagon would be preferred.

The discussion was closed by some brief but very interesting remarks by Ernest Lunn, storage battery expert for the Commonwealth Edison Company. This company has been operating over a dozen electric trucks for the last eight years, and the results have been eminently satisfactory. As the result of careful attention, and treating the equipment in the proper manner, the company is getting all the way from 9,000 to 10,000 miles out of positive plates, and it has in use negative plates which have run from 14,000 to 15,000 miles, and are still going. It is essential to keep close records of what the batteries are doing and also records of all details which enter into the vehicle equipment and maintenance.

Mr. Lunn emphasized the necessity of using some form of instrument which would give an accurate individual record of the condition of the battery. It had been suggested that the automatic feature of the dying out of the arc in the mercury arc rectifier might be taken advantage of when the amount of current flowing through the tube fell below a stable condition, but this was not dependable. As the voltage of a set of cells on charge becomes higher, the current falls off. Upon reaching full voltage this might remain steady and the current might not fall off to a point sufficiently low to automatically cut out the rectifier. If this condition were maintained for too great a time, the battery would stand a good chance of being ruined.

He described the ampere-hour meter which had been placed on the market recently, which would show the absolute condition of charge or discharge of the cell. This instrument was also possessed of an automatic cut-out feature, which made it possible to predetermine the number of ampere-hours which it was desired to give a cell, set the instrument for the proper amount of recharging and effectually and absolutely cut it out of circuit when the proper amount of charge had been secured.

Mechanical and Electrical Exposition at Worcester, Mass.

The big mechanical and electrical exposition at Worcester, Mass., already announced in our columns, was held from March 27 to April 3, and proved a great success.

The scheme of brilliant electric illumination which was adopted, largely increased the attractiveness of the show. Electric generators were specially installed to provide the power for driving the many pieces of machinery which were in operation on the floors of the building. The staging of the show and the general decorations were on a magnificent and lavish scale. Several new electrical devices were exhibited for the first time.

Among the many attractive features of the exhibition, that which attracted probably the most popular attention was the exhibit of electrical cooking apparatus which was practically demonstrated by Mrs. C. E. Baxter. The booth in which this was carried on was the brightest in the hall, being illuminated by an encircling band of incandescent electric lights. The demonstration was one of educational value, showing what may be done about the household with the aid of electricity. The utensils included electric ovens, chafing dishes, broilers, gridirons, toasters, coffee percolators, flatirons and heaters.

Among the exhibitors were the following: Norton Grinding Company, Globe Dental Company, Walker Manufacturing Company, Coates Clipper Manufacturing Company, Worcester Electric Light Company, Lowell Wrench Company, Worcester Polytechnic Institute, Stockbridge Machine Company, the Wire Goods Company, Crocker-Wheeler Company, Coghlin Electric Company.

Wireless for Milwaukee Plant.

The Pabst Brewing Company has signed a contract with the United Wireless Telegraph Company of New York for the installation of a powerful wireless station. The aerials will be strung between two chimneys at the Pabst company's plant. These chimneys are each 230 feet high.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER VII. (PART III.)—THERMAL APPLICATIONS.

ELECTRIC FURNACES.

A field of endeavor which has been advancing with rapid strides in the past decade is that involving the application

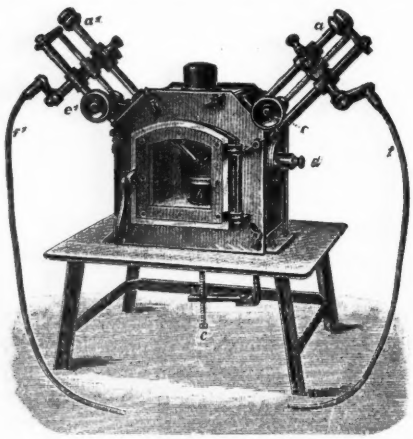


FIG. 146.—ELECTRIC ARC FURNACE FOR LABORATORY USE.

of electricity to metallurgy and chemistry. The alternating current is not available directly in all processes of this kind; the deposition of metals from solution by means of electricity requires the use of a continuous current, although, to be sure, the alternating current may be used in transmission and the direct current obtained by the use of a rotary converter, motor-generator or rectifier.

In the manufacture of certain metals like aluminum, calcium and sodium from fused electrolytes, the direct current is usually applied. However, in such reactions where only the heating effect and not the directing effect of the current is desired, the alternating current finds very ready application. An example of this is found in the manufacture of steel and its alloys by means of the electric furnace, which is now coming into more general use. Carborundum, calcium carbide and a host of compounds of that type are manufactured also by utilizing the heat generated by alternating currents.

At Niagara Falls over 2,000 horsepower is used in the manufacture of carborundum and 10,000 horsepower in the manufacture of calcium carbide. In both cases an alternating current is used at a pressure of 110 volts.

There are three types of furnaces used with alternating currents: An arc furnace, which is practically an electric arc on a large scale; the resistance furnace, where high temperature is attained by the passage of an electric current through a resistance; and the induction furnace, which might be of either the above types, but which is so arranged that the current flowing in the furnace is induced and not conducted therein.

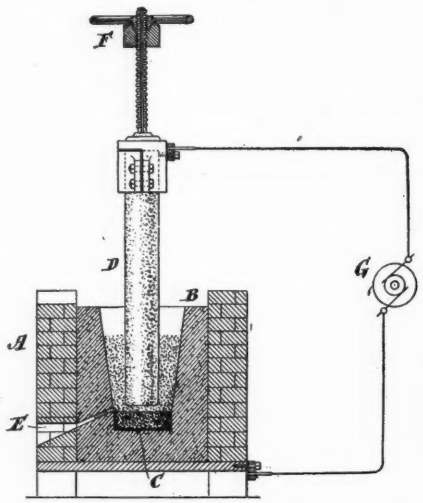


FIG. 147.—ELECTRIC FURNACE FOR CALCIUM CARBIDE.

An electric furnace of the first type is illustrated in Fig. 146. This is a form very generally used in laboratory work. It is adapted for use on either a 110-volt or a 120-volt circuit. The electrodes are

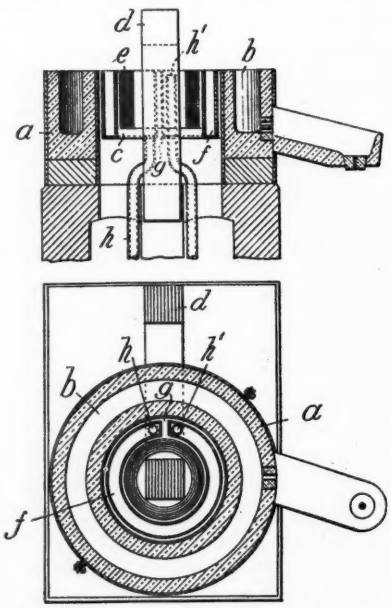


FIG. 149.—VERTICAL AND HORIZONTAL SECTIONS OF INDUCTION FURNACE.

of carbon and are adjustable by the screws as shown. The walls and top are made of some fireproof material, such as fireclay or asbestos, with a mica window in front. Crucibles containing gold or other metals can be placed underneath the arc and readily melted, as a temperature of over 3,000 degrees Fahrenheit can easily be attained. Such furnaces are very handy for making assays, alloys and for other high-temperature work.

Another type of furnace is that in which the containing vessel acts as one of the electrodes, as shown in Fig. 147. This furnace was designed for the manufacture of calcium carbide, but the same principle is used in many cases, particularly in the manufacture of the alkaline metals. The containing vessel B is of carbon, as is also the adjustable electrode D, while G represents an alternating-current generator, one pole of which is connected to the movable electrode and the other to the containing vessel.

The vessel B is filled with finely di-

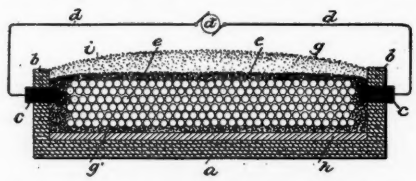


FIG. 148.—ELECTRIC RESISTANCE FURNACE.

vided coke and lime, thirty-five per cent of the former to sixty-five per cent of the latter. The bottom part of the vessel is filled with broken pieces of carbon C and the current is started by lowering the electrode D until contact is made, whereupon the heat generated melts the coke and lime together and the resulting calcium carbide may be tapped off at E. The molten calcium carbide is a good conductor of electricity and as it forms it may reach a height of two feet or more or it can be tapped out as soon as formed. Under good working conditions the amperage is about 1,500 with a pressure of fifty-five volts.

In Fig. 148 is shown a furnace of the resistance type, which is used for graphitizing carbon electrodes. When carbon articles are subjected to a high temperature a part of the carbon is converted into graphite, which materially improves them for many purposes.

The base of the furnace *a* is made of firebrick or other suitable resisting material and the ends *b* are of the same material. The amorphous carbon terminals *c* are supported in the ends and have a large cross section. The amorphous carbon articles that are to be graphitized are represented at *e* and are embedded in a packing *g* of semi-conducting material, such as ground coke. The inner bottom side of the furnace is

covered with a floor or packing *h* of highly refractory material, such as silicon carbide. There is also a covering jacket *i* of refractory material, such as a mixture of ground coke and sand.

The armature current of the induction motor is induced therein instead of conducted thereto by brushes, as already explained. The induction furnace also makes use of an induced current, thereby doing away with electrodes. One method of accomplishing this is illustrated in Fig. 149. The same letters apply to both the vertical and the horizontal section; *a* represents the brick work of the furnace; *b* the furnace chamber, which is circular in form and acts as the single winding of the secondary of a transformer short-circuited on itself; *d* is the iron core and *e* the primary winding. In this case it is necessary to protect the primary winding from the great amount of heat developed in the secondary; this is done by means of the double-walled jacket *f*, which is provided with outlets *h* and *h'* for air, water or some other cooling medium. These outlets are arranged on either side of the separating piece *g* to prevent the formation of induced currents in the cooling jacket. In this manner the primary current in *e* induces a current in the annular furnace *b*, which, of course, will be of low voltage and high amperage. The copper losses of the secondary, which would be very great with a large current, are avoided, as is also the use of electrodes, which in many cases are very troublesome.

Rio de Janeiro Tramway.

The Rio de Janeiro Tramway, Light and Power Company will ask shareholders for power to increase the capital stock from $25,000,000 to $40,000,000. It is intended to issue only a portion of the new stocks, including the $6,250,000, which has been underwritten at par.

The earnings of the Rio de Janeiro Tramway, Light and Power Company for February and January were $434,044, an increase of $39,140 over last year.

The National Electric Light Association Convention.

The Central Passenger Association has authorized a rate of a fare-and-three-fifths on the certificate plan from points in its territory to Atlantic City, N. J., where the thirty-second convention of the National Electric Light Association is to be held, and return. The convention will be held June 1, 2, 3 and 4.

THE INDUSTRIAL APPLICATION OF THE ELECTRIC MOTOR IN STEEL MILLS.[1]

BY B. R. SHOVER.

II.

MOTOR APPLICATIONS IN THE PLANT.

Central Pumping Station.—All of the water for the works is taken from the lake at one point. There are two ten-foot tunnels running directly west from the middle of the slip, feeding a sump in the pumping station located midway between the gas-washing plants of blast furnaces 8 and 9. At present there are installed four centrifugal pumps, each of 25,000,000 gallons capacity per twenty-four hours, pumping against a head of 100 feet. These pumps are driven by three-phase, 440-volt induction motors.

In order to make this installation as free as possible from interruptions due to electrical troubles, there are two main feeders from the station, one coming from power station No. 2, the other from power station No. 3. Each feeder has its own oil-switch feeding three 800-kilovolt-ampere transformers, and two of the motor-driven pumps are operated from each set of transformers. The bus-bars are provided with disconnecting switches, so that either set or both sets of transformers can be operated from either or both main feeders.

Gas-washing Plant.—In the tabulation of the use of blast-furnace gas there is an allowance of 2.5 per cent for auxiliary machinery. This auxiliary machinery is used in the gas-washing plant. There is one such plant for every group of four blast furnaces. Each gas-washing plant consists of eight washers, driven by 150-horsepower, 440-volt induction motors. These motors are fed from one of the transformer installations, but the secondaries of this transformer station can also be tied in parallel with the transformers in the pumping station, running both as a unit. In case of the failure of one of the stations, a part of the pumps and the gas washers can be operated from the other station.

Repair Shops.—To the south of the rail mill, on both sides of the main roadway, are located the various repair shops, consisting of machine shops, boiler shop, blacksmith shop, foundry, electric repair shop, carpenter and pattern shop, pattern storage, general storehouse, brick shed, stable, roll shop, and locomotive house. These shops are operated solely for the repairs necessary to the apparatus throughout the plant, and when in normal operation very little material is purchased from the outside in the finished state, practically all the work being done within the plant. A total motor capacity of 2,440 horsepower is installed for operating these shops.

The following description is given in the same order as that in which the raw material is carried through various processes, until it comes out as finished steel.

Ore Unloaders.—Located on the edge of the slip are five ore unloaders, shown in Fig. 6, of ten tons capacity each. The total weight of each machine is 890,000 pounds. The motor equipment of these unloaders is given in the following table:

TABLE A.—ORE UNLOADER.

No.	Horsepower.	Total Horsepower.	Service.	Type.
2	25	50	Bucket rotate ore gate	Series direct-current
1	50	50	Trolley	Series direct-current
1	85	85	Bucket close	Compound direct-current, 75 per cent shunt, 25 per cent series.
1	100	100	Br. & Car	Series direct-current
1	150	150	Hoist	Compound direct-current, 60 per cent shunt, 40 per cent series.
		435 total		

Total weight, 890,000 pounds.

On the trolley motor is used a dynamic brake for stopping. The change from driving to braking is made so quickly that no record whatever is made of this interruption by recording instruments. Fig. 7, shows very clearly the power required for hoisting and lowering. With the exception of the car haulage and bridge motion, all motions of the unloader are controlled through distant-controlled automatic magnetic torque-limit controllers. The master controllers for operating these motors are located in the leg of the unloader, so that the operator who rides with the bucket not only has a clear view of everything he is doing, but has absolute control of all motions of the machine.

Ore Bridges.—The ore taken out of the boats is deposited in a huge concrete trough directly in the rear of the unloaders. From this point it is picked up by the ore bridges, of which there are five. These bridges are of the cantilever type, having a total over-all length of 459

1. Abstract of a paper presented at the meeting of the American Institute of Electrical Engineers, New York, March 12, 1909. The full title of the paper is "The Industrial Application of the Electric Motor, as Illustrated in the Gary Plant of the Indiana Steel Company." The author is electrical engineer of that company.

feet. The lifting capacity of this bridge is thirteen tons of ore, in addition to the weight of the bucket. The total weight of the bridge is 238,000 pounds. The rear end of the bridge is considerably longer than is necessary to take ore out of the trough; the bridge was made this way so as to be used as a traveling crane for repairing the unloaders.

The motor equipment of the bridges is given in the following table. The trolley and hoist motions are controlled by automatic magnetic control. The secondary motions, which are seldom used, are ordinary hand-controlled. Fig. 8 represents clearly the character of load on the hoist and trolley motors of the bridge.

Bins with Transfer Car.—Between the order yard and the line of blast furnaces there is located a long steel trestle-like structure which contains the ore, coke and limestone bins. The ore picked from stock by the bridge is deposited in a transfer car of 100,000 pounds capacity, the electrical equipment of which consists of two fifty-horsepower motors operated by means of an ordinary street-car controller, and an air compressor supplying air for opening and closing the doors and for air brakes. This car is used for transferring the ore from the bridge to the appropriate bin.

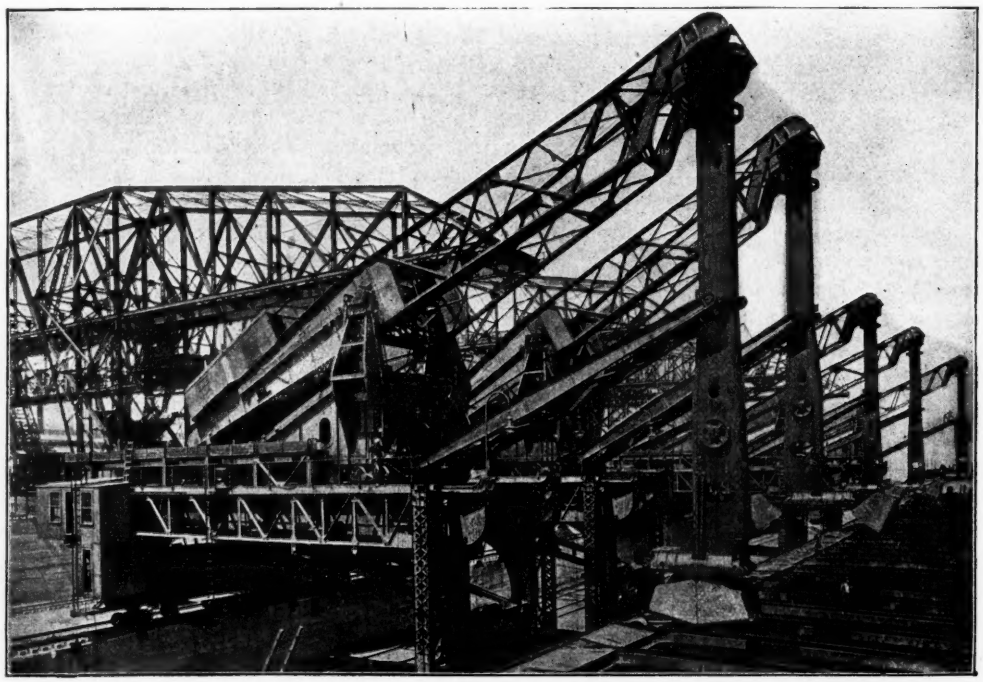


FIG. 6.—ELECTRICALLY-OPERATED ORE UNLOADERS.

TABLE B.—ORE BRIDGE.

No.	Horsepower.	Total Horsepower.	Service.	Type.
4	30	120	Bridge	Series direct-current
4	40	160	Trolley	Series direct-current
4	80	320	Hoist	Series direct-current
1	10	10	Ore pocket	Shunt direct-current
1	8.5	8.5	Air compressor	Series direct-current

Total h. p. 618.5

Weight of bridge.....238,000 lbs.
Capacity of hopper..... 60,000 lbs.

Total .....298,000 lbs.

Scale Larries.—Underneath the bins are the scale larries, driven by one twenty-one-horsepower direct-current series motor, and carrying a similar motor for opening and closing the door of the bin. This larry is used for transforming ore, coke and limestone from the various bins, in the appropriate quantities, and depositing it in the blast-furnace skip.

Skip Cars.—The material is carried from this stock house and dumped into the top of the furnace by means of a double skip, driven by a 150-horsepower compound-wound motor. The control of this skip is absolutely automatic; the operator simply starts it up, after which the accelerating, running, retarding and stopping is entirely automatic.

The total travel of this skip is 163 feet up an incline at sixty degrees to the horizontal. The time of making one trip is sixty seconds. The loads carried are approximately as follows:

Ore .....7,000 pounds
Coke .....3,600 pounds
Limestone ..... 6,000 pounds

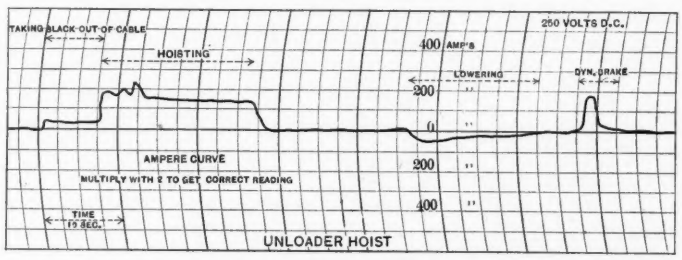


FIG. 7.—CHART SHOWING FLUCTUATING LOAD ON ORE UNLOADERS.

In spite of the variable weights carried this skip stops automatically within about four inches of the same place under all conditions. In the cast-house of each furnace is located a fifteen-ton crane for handling runners, scrap, etc.

Pig-casting Machine.—For taking care of the material from the blast furnaces on Sundays, when the open-hearth plant is not in operation, there is provided a pig-casting machine. There is a main building in which are located two double-trolley ladle cranes; the main hoist is seventy-five tons, and the auxiliary hoist fifteen tons. There are six strings of molds and conveyors for disposing of the cast material. The ladle is handled by a five-ton electrically operated jib-crane. The molds are driven by forty-horsepower induction motors and conveyed by thirty-horsepower induction motors.

Open Hearths.—Each open-hearth plant consists of fourteen sixty-ton furnaces. The molten metal from the blast furnaces is poured into a 300-ton mixer by a seventy-five-ton electric ladle crane of the same design as that in the pig-machine

building, and the metal is carried to a point in front of the various furnaces by an electrically operated hot-metal car whose equipment consists of two twenty-five-horsepower, 250-volt series motors, operated by a standard series-parallel controller. The ladle from this car is handled and the contents poured directly into the open-hearth furnaces by another seventy-five-ton ladle crane.

The cold scrap for charging the furnace is stored and handled in the stock-yard, which is entirely covered by two five-ton electric traveling cranes. The stock is handled by means of electromagnets, each one capable of handling from 1,000 to 2,000 pounds of scrap, according to the character of the material, or of lifting 10,000 pounds in large pieces. After this scrap is loaded, the charging boxes are shifted in front of the open-hearth furnaces and the contents put in by means of a low-type charging machine, as shown in Fig. 9. The equipment consists of a main hoist, with a thirty-horsepower series motor; bridge travel, two thirty-horsepower series motors; trolley, twenty-horsepower series motor; tilting, eleven-horsepower series motor; rotate, 3.25-horsepower series motor.

The steel is handled in sixty-ton ladles by three 125-ton ladle cranes. The electric equipment is as follows: Main hoist, 110 horsepower; first auxiliary hoist, fifty horsepower; second auxiliary hoist, thirty horsepower; main trolley, thirty horsepower; auxiliary trolley, eleven horsepower; bridge travel, two fifty-horsepower motors. The controllers for this apparatus, except that for the main hoist on all ladle cranes (which is automatic magnetic control), are of the ordinary hand-operated lever type.

The electric equipment of the coal-handling apparatus in connection with the gas producers for these furnaces consists of a coal crusher driven by a twenty-five horsepower direct-current motor; a double-skip coal elevator driven by a motor similar to that on the coal crusher; and four hopper cranes, each driven by 7.5-horsepower series motor. The hopper cranes are used for distributing crushed coal in overhead bins directly into the producers.

The control of the skip is entirely automatic in its action. As the descending car approaches the bottom point of its travel, it opens the door of the coal bin; in stopping it rests on a counterweighted lever. When the skip is nearly filled with coal the counterweight on this lever is overbalanced, the skip dropping down about three inches more. This actuates the switch which starts the skip on its upward travel, its first action being to close the door of the coal bin. The operation is repeated by the second skip, and continues, unless stopped, until the coal bin is entirely empty.

As part of the open-hearth plant there are two stripper buildings. One of these buildings contains one, and the other two, 200-ton electrically operated stripper cranes. These cranes are equipped with 100-horsepower series motors on the main hoist; a duplicate to the above on the stripping hoist; thirty-horsepower trolley, and one fifty-horsepower, on the bridge.

In the soaking pits are three 7.5-ton soaking-pit or ingot cranes. Each of these cranes has a five-ton, high-speed auxiliary hoist on the trolley for repairing the pits. The electrical equipment is as follows: Main hoist, fifty horsepower; auxiliary hoist, thirty horsepower; trolley, 7.5 horsepower; bridge, two fifty horsepower; tongs turning and opening, five horsepower.

For delivering the ingots from the pit to the first table in the rolling mill two ingot buggies are used, for which a special control has been designed. Each buggy is intended to take care of six rows of four pits, which are located, respectively, north and south of the table. To prevent the two buggies colliding, should both happen to be coming toward the table at the same time, the trolley bars through which the current is transmitted to the motors on the buggies are in three sections, one section in front of the table and one long section on each end of that. Each controller has six points corresponding to the six rows of pits, one point corresponding to the table and one to the off position. The operator can throw his controller to the point representing the row of pits to which he desires to run, and when the buggy reaches this point it is automatically stopped. Return motion with controller on the table position will bring the buggy up to the table—where, however, on account of the great accuracy of the stop, the buggy is not stopped automatically, but at the will of the operator. When one buggy is at the table it is impossible for the other one to reach that point, as the two controllers are so interlocked as to prevent this.

[To be continued.]

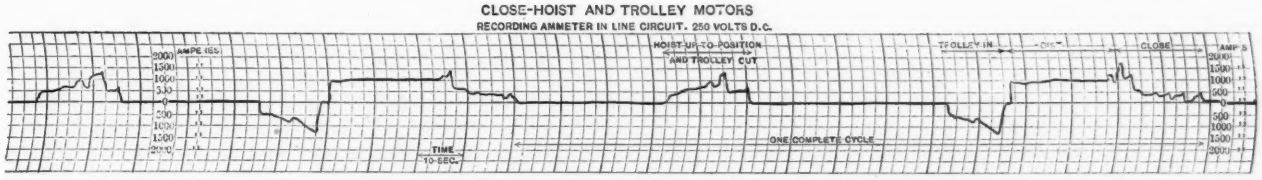


FIG. 8.—CHART SHOWING VARYING LOAD ON ORE BRIDGES.

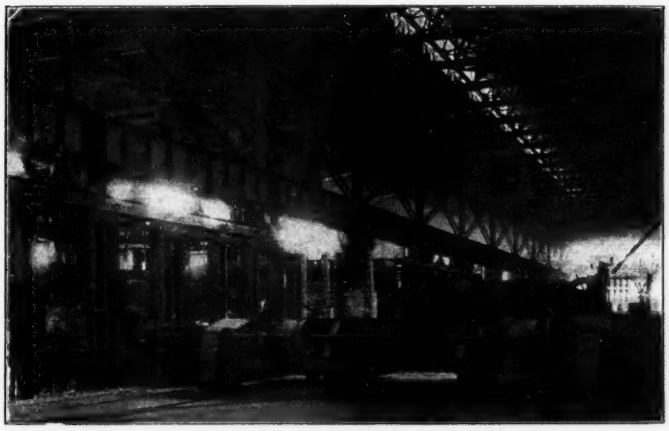


FIG. 9.—LOW TYPE OPEN-HEARTH CHARGING MACHINE.

Electrical Notes from Great Britain.

(By our British Correspondent.)

Satisfactory progress is being made with the extensions at the London County Council's generating station at Greenwich and with the central car-repair depot. Four turbo-generators, each of a capacity of 5,000 kilowatts, which are required for the second portion of the station, are erected and working. Two further generators of the same capacity are now in course of construction, and when these have been erected the total power of the station will be 34,000 kilowatts. The cost of the two turbo-generators which have been erected is £43,195, and that of the two others will be £40,800. The central car-repair depot has been erected in Woolwich Road and a large portion of the plant installed. A single line of conduit has been laid for taking cars into this depot and another will be laid as soon as street widening has been effected. The Council's tramway officers expect great things from this depot in the direction of more efficient working of the system. The site of the depot is seven acres. The first section of the depot has cost £51,400, with £16,000 more for its plant, tools and other machinery.

The system of the National Telephone Company, Ltd., is to be taken over by the government in the year 1911, and between now and then many nice points will arise for settlement in regard to the terms and conditions of the purchase. Already a point of considerable difficulty has arisen and has been the subject of so far unsuccessful negotiation between the Postmaster-General and the company. Unless an early agreement is arrived at the employment of some thousands of men engaged in constructional work will be jeopardized and the legitimate spread of telephonic communication will be seriously interfered with. The attitude of the company is as follows: With the purchase of its plant looming in the near future, and that upon a basis not of actual expenditure, but rather upon what is called "plant values" (that is, cost price less depreciation), the directors have seriously considered their position in relation to capital expenditure. Of course in telephonic development it is necessary to lay down plant in advance of requirements, but as at the date of transfer only the then value will be paid, it is felt that the time is at hand when only such plant can be provided as will bring revenue during the period of the business. They are not disposed to continue to provide plant and apparatus for the future beyond 1911, with heavy charges for interest, depreciation and reinstatement against which the company would have no revenue and for which they would possibly receive only a depreciated value. During the remainder of their period therefore the National Company directors propose to endeavor to make the whole of their existing plant revenue-earning within the period of their license. That the company has been gradually staying its hand in expenditure on construction of exchange and private stations of late is shown by the figures spent in this direction during the last three half years, namely, $2,728,760, $2,482,915, $1,805,395. The total income of the company during 1908 was close upon $15,000,000, an increase of about $1,250,000. The working expenses were $8,500,000, an increase of roughly $800,000.

At a recent meeting of the Institution of Civil Engineers, Magnus Mowat, engineer to the Millwall Dock Company of London, gave an account of some electrically-driven grain-handling and storing appliances that have recently been installed at a new granary constructed at the Millwall Docks. Full details of the electrical equipment are not at present to hand. For the moment it may be said that the grain is taken direct into store by entirely mechanical means, which has reduced the time occupied in discharging a ship by fifty per cent. The installation consists of a dolphin, elevators, silos and granary, and provides for the discharge and weighing of 550 tons of grain per hour out of the ship and for its delivery either partly or wholly into granary, silo or barge. The granary and silo elevators are of the bucket type, and the bands, which have a total length of two-and-one-quarter miles, are electrically driven. The various machinery is driven by twenty-four electric motors, aggregating 354 horsepower, which are controlled from a switchboard in the basement. This is in telephonic communication with all parts of the granary and dolphin.

What one speaker described as a notable contribution to the practical theory of magnetism was brought before the London Physical Society by Prof. Silvanus P. Thompson. It was a joint production by the professor himself and E. W. Moss and was entitled "The Self-demagnetizing Factor of Bar Magnets." First, the significance and definition of the self-demagnetizing factor of magnets in general and of bar-magnets in particular, was discussed. A redetermination of the values of the self-demagnetizing factor for bar-magnets of circular section followed. In a third and final section was given a determination of the values of the self-demagnetizing factor for bar-magnets of rectangular cross-section of various proportions. Dr. A. Russell expressed thanks to the authors for lucid comments on the self-demagnetizing factor and for the important experimental results embodied in the paper.

Among recent topics brought before the Institution of Electrical Engineers that of the use of large gas engines for generating electric power has had the largest share of attention. The paper by Messrs. Andrews and Porter, already referred to in these pages, was the basis of good discussions not only at the London meetings but also at Manchester and Dublin. At the last Manchester meeting (March 9), R. G. and J. G. Cunliffe gave an account of a study on electric-traction vagabond currents, the paper being the outcome of an experimental investigation of the principal vagabond-current phenomena. Their remarks, while incidentally throwing a little further light upon the magnetic effects, were chiefly directed to the elucidation of the reasons for the non-fulfillment of the early predictions of electrolytic destruction, to the possibility of such damage being encountered, and to the precautions thereby rendered necessary. Briefly summarized their conclusions are: (1) In order to reduce danger of corrosion to a minimum it is necessary that the rail drop should be limited; (2) the limits generally imposed are still too high to afford protection against magnetic disturbances, and so special regulations fixing the maximum length of section ought to be imposed in important cases.

On March 10 at the Birmingham sectional meeting A. M. Taylor gave a number of notes and suggestions on the subject of extending the limits of power transmission as applied both to long-distance transmission of power and to power companies' areas. His object was to draw attention to certain possibilities in the

way of commercial developments that he thought had been somewhat overlooked. He first dealt with long-distance power-transmission overhead lines and said his proposal was that electrical storage on a large scale should be carried out at the distributing centres, the reliabiilty of the line being thereby increased to an extent that would warrant a second line being dispensed with. For underground cables Mr. Taylor also argued in the direction of putting down accumulators at the distributing centres, or else offering customers such terms for current during restricted hours for charging purposes as would induce them to put down accumulators themselves. He said that it would, no doubt, be readily conceded that any means that would permit of a battery installation on either a waterpower scheme or a power company's scheme being commenced with a minimum of outlay and a maximum of reliability is to be welcomed. When put down on the lines usually followed accumulator batteries did not readily lend themselves to extensions without a sacrifice in floor space and a considerably increased capital expenditure above what Mr. Taylor thought necessary.

The street lighting of the city of London never has been a department in which electrical engineers have boasted of great success. Not that they have any want of faith in the capability of modern electric systems and lamps to acquit themselves satisfactorily at a reasonable cost, but because of lack of adequate opportunity and a predilection for experiment with gas lighting. A fair field and no favor was what electrical engineers sought for. The City of London Corporation has for years been making experiments with rival systems, and that its experience has not enabled it to make up its mind is evidenced in its decision, just arrived at, to despatch a deputation of members of its streets committee to Paris, Berlin, Vienna, Brussels, Hamburg, and other cities on the Continent, to inquire into the different systems in use there.

Many of our electric tramway systems had a less prosperous year than they desired in 1908, trade depression and labor troubles being the chief causes of the public traveling less than usual. The results are now being made public. The Liverpool corporation tramways' report shows that 122,000,000 of passengers were carried on the extensive trolley lines, which represent a capital expenditure of more than $10,000,000, the receipts being $2,820,000 for the year. This shows a decrease of 1.7 per cent, which is exactly the same as the percentage decrease in passengers carried. There is a service of 534 electric cars with an ordinary daily service of 402. The car mileage was 12,244,353, with average earnings of 11.04d per car-mile, against 11.24d in 1907. During the year twenty-two persons who had been knocked down or had fallen in front of cars, were pushed clear of the wheel by the plow lifeguard without any serious injuries. The number of fatalities decreased from 1 in 12,404,-324 in 1907 to 1 in 15,240,985 in 1908. There were eight deaths, compared with twenty-four fatal accidents caused by vehicles other than tramcars, occurring in the city of Liverpool during the year. Liverpool was one of the places where the authorities wanted to give the trackless trolley system a trial for certain outside routes, but when the matter was put before a town's meeting the proposal was rejected. It remains to be seen whether it will secure any better measure of success in other places that have shown themselves anxious to give it a trial.

ALBERT H. BRIDGE.

London, March 27.

New Army Rifle with Electrically Lighted Sights, for Night Use.

The latest development of the army gun is being manufactured in the Springfield (Mass.) armory. Work on the rifle has been kept a close secret by the local armory officials.

This particular piece of ordnance is for use only at night to facilitate getting proper aim. On each side of the tip end of the gun barrel is a tiny electric bulb about three-eighths of an inch in diameter. On the under side of the rifle stock is a battery and on the steel trigger guard is a button. Upon pressing the button, connection is made between the electric battery and the lights on the barrel. The small electric lights bring the rifle sight on top of the barrel into the clear vision of the shooter, thereby enabling him to get a sure aim. As the gun is operated only at twilight or in the darkness, it must naturally be used at fairly close range, with large objects serving as the target. The idea is indeed a novel one and it is believed, in time, will revolutionize methods of warfare at close range during night conflicts.

The gun possessing this unique arrangement is the regular size Springfield rifle, with a barrel twenty-eight inches long. The idea of an electric battery gun was suggested by a Western man not long ago. The inventor first tried the scheme on a "Krag" rifle, and later the invention came to the attention of the government officials. The invention was of such a novel and at the same time practical nature, that ordnance authorities evidently decided to try it out with the United States Army rifles.

Small Progress on Illinois Central's Electrification Plans.

In a recent conference between city officials of Chicago and officers of the Illinois Central Railroad to consider the progress being made on the terminal-electrification plans, the railroad representatives submitted what was said to be the twelfth tentative plan worked out by the road's engineers. They made much of the great intricacy of the problem and the related difficulties of rearrangement of tracks and signal systems. President Harahan of the railroad company said that merely a start had been made on the plans and that it was impossible to hazard a guess as to the time that construction work might be expected to be commenced. The present project contemplates the electrification of the suburban service only from the downtown terminal at Randolph Street to Flossmoor and South Chicago. In a recent interview E. H. Harriman said that the immediate electrification of the Illinois Central terminals was a luxury and was out of the question unless the city was willing to pay half the cost. The attitude of the city officials in this matter was disclosed by the introduction in the State Legislature of a bill empowering cities and villages to prescribe by ordinance the motive power with which railroads may operate within their limits.

Mono-rail System for New York City.

The first permission for the installation of a mono-rail rapid transit service to be granted by New York city has been given by the Board of Estimate to the Pelham Park & City Island Railroad companies, forming a system from Bartow station to a point near Belden Point, the Bronx. Horse power is at present in use on both lines, but electricity is to be substituted with a system known as the American mono-rail, the plans for which were approved some time ago by the New York State Public Service Commission.

As the mono-rail is purely experimental, the companies are required to restore the present system should the venture not prove successful. The park commissioner of the Bronx is given authority to see that the line be located in the most advantageous manner.

New York City Traction Operations.

The New York Public Service Commission made public on March 31 figures showing the results of operations on all the traction companies in New York city for the quarter ended December 31, 1907. The statement showed that twenty-seven different companies received from operation $17,798,098, together with about $1,000,000 other income.

The operating expenses for the quarter on all the companies were $10,712,836, leaving net earnings of $7,085261. Taxes were $1,399,833, and interest $1,942,378. Rentals were $2,974,657, and other charges $111,496, making total charges of $6,428,365, and net income of $656,-896 on all the twenty-seven companies for the quarter.

The most remarkable of the figures were those showing the results of operation on the surface railways in Manhattan and the Bronx, which have been in the hands of receivers since September, 1907. An idea of the shrinkages between the present values as reported to the Public Service Commission and given out in the tabulations may be obtained from the fact that the assets of the surface companies in Manhattan and the Bronx are now fixed at $19,584,078, and liabilities at $19,661,059, as against claimed assets of $150,000,000 in the consolidated report on all the lines made on June 30, 1906, to the state railroad commission.

The Third Avenue road, with its $5,-000,000 of first mortgage and $40,000,000 of general mortgage bonds and $16,000,-000 of stock, now reports assets of $7,-379,101, according to the figures which the Public Service Commission gives out covering the Third Avenue Railway proper, the Dry Dock, East Broadway & Battery, the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway, the Southern Boulevard Railway and the Union Railway.

The Metropolitan Street Railway, stripped of the Second and Third Avenue roads, the Central Park, North & East River and Twenty-eighth and Twenty-ninth streets, report assets of $3,003,337 and liabilities of $3,712,438.

The fixed charges prior to the receiverships for interest and rentals were about $11,500,000. Now, with defaults on the $45,000,000 bonds of the Third Avenue and all the rentals of its subsidiaries, several of which have passed into the hands of separate receivers by virtue of defaults on their own bonds; with defaults on both mortgages of the Metropolitan, on the Twenty-eighth and Twenty-ninth streets bonds, and the Second Avenue bonds, besides defaults on the rental of the Metropolitan to the New York City Railway, the Third Avenue to the Metropolitan and the Second Avenue and Central Park, North & East River to the Metropolitan, interest and rentals on the entire system have been reduced to $839,805.

The reports given out by the Public Service Commission, however, show net income after payment of operating expenses and the remaining charges of $131,207, and the figures for the December quarter cover a period when the curtailment of the free transfer system had reached its present extent.

Following are the figures on income account and the statement of assets and liabilities on the Third Avenue, the Metropolitan and all lines in Manhattan and the Bronx:

INCOME ACCOUNT QUARTER ENDED DECEMBER 31, 1908.

Gross earnings f'm operation	Third Avenue.	Metropolitan Street.	All Lines.
	$1,519,017	$3,277,274	$5,173,660
Oper. expenses	1,053,411	2,567,250	3,966,283
Net f'm operation	$ 465,606	$ 710,024	$1,207,377
Other income	165,830	109,783	279,146
Gross income	$ 631,436	$ 819,807	$1,486,523
From which deduct:			
Taxes	$ 67,685	$ 339,975	$ 427,297
Interest	131,336	154,999	311,521
Rentals	.....	515,887	528,284
Other	28,067	60,149	88,214
Total	$ 227,088	$1,071,010	$1,355,316
Net income	404,348	*251,202	131,207

*Deficit.

ASSETS AND LIABILITIES.

Total assets	$7,379,101	$3,303,337	$19.584,078
Total liabilities	6,363,915	3,712,438	19,661,059
Surplus	1,015,185	*709,100	*76,981

The Interborough Rapid Transit Company for the December quarter had gross earnings from operation of $6,786,899 and other income of $341,988. Its operating expenses were $2,691,804 and its gross income $4,437,083. Taxes, interest, rentals and other charges aggregated $3,-052,802, leaving a net income of $1,384,-280, applicable to the payment of two-and-one-fourth per cent for the quarter on $35,000,000 of stock.

The Brooklyn Rapid Transit Company had gross earnings of $4,641,344 and other income of $116,063. Its operating expenses were $3,034,262, leaving gross income after payment of operating expenses of $1,723,145. Taxes, interest, rentals and other charges were $1,710,169, leaving a net income of $12,976 for the quarter.

These figures, however, covered only the Brooklyn Heights Railroad Company, the Brooklyn, Queens County & Suburban, the Brooklyn Union Elevated, the Coney Island & Gravesend Railway Company, the Nassau Electric Railway, the Sea Beach Railway and the South Brooklyn Railway Company.

Industrial Education to be Discussed by the American Institute.

A special meeting of the American Institute of Electrical Engineers will be held in New York city on Friday, April 16, at 8 p. m. This meeting will be under the auspices of the Educational Committee, a sub-committee of the Meetings and Papers Committee. Herman Schneider, dean of the College of Engineering of the University of Cincinnati, will present a paper entitled "Fundamental Principles of Industrial Education." It is hoped to have a large attendance and a spirited discussion.

The aim of the Educational Committee has been to lay before the Institute members the problems of industrial and technical education. Last year the committee devoted its attention to the problems of technical education. It has been deemed wise this year to present some phases of more elementary industrial training. To this end, Dean Schneider has been invited to give the members of the Institute the results of his study and experience along this line. This he has done in a brief paper, which is designed to provoke a discussion of the practical aspects of the training of men as mechanics, draftsmen, etc. A plan for applying the co-operative idea in electrical-engineering education was outlined in a paper by M. W. Alexander, at the annual convention last year. Dean Schneider believes that the co-operative principle applies to industrial as well as to technical training, and that it can be carried out in a practical manner.

New England Street Railway Club.

On March 25 the New England Street Railway Club held its annual meeting and banquet at the Hotel Somerset, Boston. The club has been organized nine years, during which its influence and membership have steadily increased, the latter aggregating 727 names at present. For the next fiscal year W. D. Wright, of Providence, R. I., was elected president. The banquet was exceptionally well attended. The toastmaster was D. L. Prendergast, of Boston; among the speakers were James F. Shaw, president of the American Street and Interurban Railway Association; J. F. Jackson, formerly chairman of the Massachusetts Railroad Commission; and P. F. Sullivan, president of the Old Colony and of the Boston & Northern Railway companies. The discussion was largely about public control of public-utility corporations, and a policy fair and equitable to both public and corporations was strongly urged.

Preliminary Programme for the Institute Convention.

As already announced, it has been decided to hold the next annual convention of the American Institute of Electrical Engineers at the Hotel Frontenac, Thousand Islands, Frontenac, N. Y. The convention will begin Monday, June 28, and will end at a time to be announced later. A tentative list of the papers to be presented is as follows:

"Some Considerations in Designing Heavy-Capacity Fuses." By L. W. Downes.

"A Sketch of the Theory of the Adjustable-Speed, Single-Phase Shunt Induction Motor." By F. Creedy.

"Vector Representation of Non-Harmonic Alternating Currents." By Bonroku Arakawa.

"Split-Pole Converters and Storage-Battery Regulation at Gary, Ind." By J. L. Woodbridge.

"The Effect of Frequency Upon the Cost of Alternators." By C. J. Fechheimer.

Two papers on high-tension transmission subjects. By R. D. Mershon.

"The Reduction in Capacity of Induction Motors, Due to Unbalancing in Voltage." By S. B. Chartres and W. A. Hillebrand.

"The Heating of Induction Motors." By Alexander M. Gray.

Telephone paper. By J. J. Carty.

Three power papers. By D. B. Rushmore.

"Sparking-Point Distance."

"The Resistance and Reactance of Armored Cables." By J. B. Whitehead.

Two educational papers. By H. H Norris.

"Generators for 100,000 Cycles." By E. F. Alexanderson.

"Repulsion Motors with Variable-Speed Shunt Characteristics." By E. F. Alexanderson.

Ithaca Section, American Institute of Electrical Engineers.

A joint meeting of the Cornell Sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers was held Tuesday, March 30, in Sibley auditorium, about fifty members of each society being present.

The meeting was presided over by H. See, secretary of the local branch American Society of Mechanical Engineers. B. R. Shover's recent paper before the Institute on "The Application of Electric Motors to Steel Mills," as illustrated in the Gary plant, was abstracted by G. D. Gates and F. L. Lucker. Mr. Gates presented the mechanical-engineering features of the installation, especially emphasizing the gas-engine equipment and the processes in use to fit the producer gas for use in the engines. Mr. Lucker took up the growth of motor applications in steel-mill work and cited the various examples described in this paper.

An animated discussion followed the presentation of the abstracts. Prof. R. C. Carpenter compared the cost of installation and operation of gas engines and steam turbines, giving as his opinion that the latter installation would result in a lower cost per kilowatt-year. This was explained in part as due to the high rate of depreciation which obtains in gas engines, due to the dust in producer gas, and to the high cost of repairs.

Professor Norris showed how much more severe is the service of steel-mill motors than that of the street-car motor, since the steel-mill motor in many cases works in close proximity to white-hot or molten metal. He emphasized the fact that the most important characteristic of these motors is reliability.

B. C. Dennison called attention to the direct-current motors and equalizer set used in the Illinois Steel Company's plant at South Chicago. Professor Kimball remarked the too great complexity of much of the steel-mill apparatus, especially the ore unloaders and automatic motor starters. Professor Hess discussed the need of an occasional shutdown of blast furnaces in order that needed repairs be made.

New York Section, Illuminating Engineering Society.

It is proposed by the New York section of the Illuminating Engineering Society to set aside a regular meeting in the early fall to secure suggestions from everyone interested in the subject of illumination as to what constitutes an "Illuminating Engineer." Albert J. Marshall, secretary of New York section, 227 Fulton Street, is inviting opinions and suggestions and the society is desirous of specifically answering this question.

As has already been announced, the society will endeavor at the future meetings to have one paper dealing with the technical and theoretical questions and the other dealing with the hygienic, practical or æsthetic features of the work.

The April meeting will be held in the Engineering Societies Building and one paper entitled "Calculation and Design of Illuminating" will be presented by Alfred A. Wohlauer and another paper, of a purely practical nature, will also be presented.

It is expected that some time in May the New York section will hold a general meeting with the Municipal Arts Society and the National Arts Club. At one of these meetings E. L. Elliott will deliver a lecture on "Exterior Lighting."

At the regular May meeting there will be a paper entitled "The Evolution and Development of the Flaming Arc Lamp" by L. J. Auerbacher.

The National Association of Cotton Manufacturers.

The annual meeting of the National Association of Cotton Manufacturers will be held on Wednesday and Thursday, April 28 and 29. The sessions will be held in the Mechanics Fair Building, Huntington Avenue, Boston, Mass. These sessions will take place during the exposition of the Textile Exhibitors' Association, which will hold a demonstration of textile machinery during the last week of April. Sessions will be called to order on Wednesday at 11 a. m. and 2 p. m., and on Thursday at 10 a. m. and 2 p. m.

It is announced that the Honorable Eben S. Draper, governor of the state of Massachusetts and a member of the association, will deliver the address of welcome.

A programme of especial interest and importance to textile manufacturers has been arranged. Among those papers which are of direct interest to the electrical fraternity are the following: "Advantage of Variable Speeds for Ring Spinners," "Commutator Grinding" and "Improvement in Lighting Large Textile Areas with High-Efficiency Lamps."

Public Service Corporation Dinner.

Electrical novelties were a feature of the dinner at the Hotel Astor, New York city, on March 26, of the Superintendents' Association of the Public Service Corporation of New Jersey.

There were twenty-five guests, and the table had been fashioned in the shape of an incandescent bulb. Growing plants rested on the floor, but their branches mingled with the cut flowers on the table.

Running around the table was a row of very small violet-colored incandescent bulbs, representing the filament or carbon wire of the standard bulb.

Dudley Farrand, general manager of the company, was toastmaster.

THE VENTILATION OF THE FLAMING ARC.

BY R. F. PIERCE.

Ever since the invention of the flaming arc lamp the disposal of the profuse ash from the arc has been one of the most troublesome problems.

This ash is mainly composed of metallic oxides, and its character depends principally upon the conditions of combustion, the ash being light and finely divided when produced at a high temperature without access of air, and heavy and coarse when the temperature of combustion is lowered or the surrounding vapors mixed with air.

The first expedient to secure better combustion was the economizer, an inverted bowl of refractory material, in which the arc was maintained. This device materially increased the temperature of the arc, and was very effective, but failed to provide ventilation of any sort.

The next step was the providing of a long ventilating sleeve, "B," and ash tray, "C" (Fig. 1), the former to produce sufficient draft to withdraw the products of combustion, and the latter to deflect the incoming currents of air along the sides of the globe and permit them to become heated before coming in contact with the arc. Both of these devices were of some value, but left much to be desired. The heating of the fresh air supply was insufficient to secure perfect combustion, and the ventilating sleeve did not produce sufficient draft to withdraw the heavier particles, which are merely deflected toward the sides of the globe.

The latest and most effective device is the inner globe, "A" (Fig. 2), of a special refracting glass, forming a "combustion chamber," which permits none but highly heated vapors to come in contact with the arc. The small area of the lower opening retards the entrance of the air from the outer globe until sufficiently heated by contact with the inner globe, and in this manner the high temperature of the metallic vapors is maintained, and a finely divided ash produced that is easily withdrawn through the sleeve "B."

The few heavy particles that do form are compelled to fall directly into the ash tray, "C," and the deposit on the globe is eliminated. The deposit on the inner globe is but a fraction of that which is produced on the inside of the outer globe when the inner globe is not used, and is much more easily removed.

The inner globe may be made with refracting prisms, securing any desired distribution of light.

In a recent test of the efficacy of the prismatic inner globe by the Electrical Testing Laboratories, it was found that it absorbed only about five per cent of the total light, and altered the maximum distribution of light to an angle of thirty per

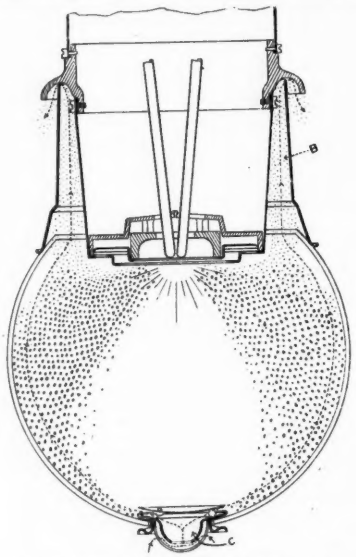


FIG. 1.—FLAME-ARC LAMP CONSTRUCTION, SHOWING VENTILATING SLEEVE AND ASH TRAY.

cent from the horizontal. This distribution permits the use of the flaming arc lamp for uniform street lighting without hanging the lamp at an unusual height.

It was found that the deposit of ash

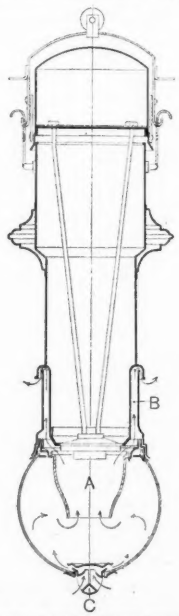


FIG. 2.—FLAME-ARC LAMP CONSTRUCTION, SHOWING INNER GLOBE.

was almost entirely eliminated, whereas a lamp identical in every respect, but without the inner globe, was heavily coated on the inside of the globe after a few hours' operation.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

CUMBERLAND TELEPHONE.

The report of the Cumberland Telephone and Telegraph Company for the month of February and two months ended February 28, 1909, compares as follows:

	1909.	1908.
February gross	$ 524,412	$ 511,848
Expenses	311,946	285,980
February net	$ 212,466	$ 225,868
Charges	42,627	37,552
February surplus	$ 169,839	$ 188,315
Two months gross	1,058,270	1,031,579
Expenses	617,072	572,060
Two months net	$ 441,198	$ 459,519
Charges	87,374	75,429
Two months surplus	$ 353,824	$ 383,090

KEYSTONE TELEPHONE.

The report of the Keystone Telephone Company for the month of February and eight months ended February 28 compares as follows:

	1909.	1908.
February gross	$ 89,123	$ 86,241
February net	45,409	41,199
February surplus after interest and renewals	11,194	6,639
Eight months gross	707,141	698,823
Eight months net	357,168	329,180
Eight months surplus after interest and renewals	81,568	55,607

AURORA, ELGIN & CHICAGO.

The report of the Aurora, Elgin & Chicago Railroad Company for the month of February and eight months ended February 28 compares as follows:

	1909.	1908.
February gross	$ 94,335	$ 85,552
Expenses	58,218	54,825
February net	$ 36,117	$ 30,727
Charges	28,260	28,184
February surplus	$ 7,856	$ 2,542
Eight months gross	976,017	962,759
Expenses	528,907	527,476
Eight months net	$446,110	$435,280
Charges	222,928	222,879
Eight months surplus	$223,181	$212,401

PIONEER TELEPHONE AND TELEGRAPH COMPANY.

The report of the Pioneer Telephone and Telegraph Company for the year ended December 31, 1908, compares as follows:

	1908.	1907.
Gross revenue	$1,356,703	$1,125,388
Exp., taxes, reserve, etc.	1,187,852	935,968
Net	$ 168,851	$ 189,420
Dividends	146,100	125,475
Surplus	$ 22,751	$ 63,945

A comparative statement of stations and miles of line shows as follows:

Exchange stations	31,051	26,678
Toll stations	707	731
Total	31,758	27,409
Miles of toll pole line	5,065	4,967
Miles of toll line wire	26,890	24,721

President Eugene D. Mins says: "The directors have followed the policy outlined in last year's report, in which it was stated: 'It is considered unwise to make any large extensions other than those absolutely needed to protect our

property and serve our imperative needs.' The legal questions involved in the amalgamations of the two territories as one state, under a constitution that provided for complete control of public-service companies by a state corporation commission, brought into question our rights under franchises previously granted by the cities and towns, resulting in a chaotic condition that has been very difficult to handle, and exceedingly annoying both to the company and its patrons.

"It has been impossible for the company to make the improvements and extensions needed in a number of places until its legal rights and its manner of operation could be definitely determined.

"The directors feel that the prospects for the future are better than they were a year ago, and with our field clear of the complications mentioned, we hope that the earnings will be sufficient to pay a larger return on the capital invested, so that additional funds can be obtained to provide any additional service demanded by the public.

"The total number of telephones installed during the year were 17,717; the total number of telephones removed during the year, 13,368, and the net gain for the year, 4,349, making an increase of 15.87 per cent over the total stations, January 1, 1908."

MARCONI WIRELESS TELEGRAPH.

The Marconi Wireless Telegraph Company of America has issued a financial statement for the year ended January 31, 1909. The general balance sheet compares as follows:

Assets.	1909.	1908.
Pat. rights, good-will, etc.	$5,494,269	$5,491,885
Stations and exper. work	117,308	126,968
Appar. on hand	17,679	16,853
Accounts receivable	9,771	17,946
Cash	610	1,757
Treasury stock	.....	145,200
Furniture and fixtures	992	1,060
Organization expenses and deferred accounts	448,803	422,422
Unexpired insurance	588	550
Total	$6,090,020	$6,079,444
Liabilities.		
Capital stock	*$6,044,800	$6,044,800
Marconi W. of London	20,692	16,281
Accounts payable	13,928	8,763
Notes payable	10,600	9,600
Total	$6,090,020	$6,079,444

*Less $145,200 treasury stock.

Secretary J. Bottomley says:

"The year 1908 has been one of considerable depression, not only in business circles generally but especially in shipping business and travel, and when we inform our stockholders that as compared with 1907, the year 1908 shows a falling off in Atlantic travel coming into the port of New York of 10,558 first-cabin passengers; 39,209 second-cabin passengers; 726,207 steerage passengers, and 133 trips of the various steamships, the fact that this company shows but little improvement over 1907 is not to be wondered at.

"Receipts for short-distance, *i. e.*, shore to ship within a radius of 300 miles, show an increase of about $5,000 in gross receipts in 1908, as compared with 1907, but on the other hand receipts for long-distance transmission have fallen off considerably, partly because some of the steamship lines could not, under the depressing circumstances, afford the luxury of daily news for their passengers, and partly because our long-distance receipts depend, to a great extent, on the traveling public.

"There was a further saving this year in general and administration expenses of about $7,000."

The annual meeting of the Marconi Wireless Telegraph Company of America will be held at 15 Exchange Place, Jersey City, on April 19.

TWIN CITY RAPID TRANSIT.

The report of the Twin City Rapid Transit Company for the month of February and two months ended February 28 compares as follows:

	1909.	1908.
February gross	$483,101	$453,944
Expenses	273,784	253,644
February net	$209,317	$200,300
Charges, taxes and preferred dividends	133,963	122,789
February surplus	$ 75,354	$ 77,511
Two months gross	1,008,762	923,335
Expenses	559,609	511,844
Two months net	$449,153	$411,991
Charges, taxes and preferred dividends	267,926	244,744
Two months surplus	$181,227	$167,247

CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANY.

The Central & South American Telegraph Company has issued its annual report for the year ended December 31, 1908. The income account compares as follows:

	1908.	1907.
Gross	$1,664,506	$1,749,045
Expenses	677,160	556,666
Net	*$987,346	$1,192,379
Dividends	574,260	551,031
Balance	$ 413,086	$ 641,348
Repairs and renewals	84,558	33,412
Surplus	$ 328,528	$ 607,936
Previous surplus	1,019,819	1,370,450
P. and L. surplus	$1,348,347	$2,478,386

*Equal to 9.87 per cent earned on the $10,000,000 capital stock.

Herbert Kingsford, the company's superintendent, in reviewing the cable and reconstruction work to the end of 1908, says:

"For some time past heavier cable has been substituted for the higher types wherever experience has shown this to be advisable and the whole system is now apparently safe in this respect.

"A deviation recently made in the direct cable off Talara and another off Pescadores, Peru, should render this cable as safe as the original cable which has never failed in the latter place, so that there is now no portion of the line that can be regarded as particularly vulnerable, and it is reasonable to suppose that comparatively little renewing or repairing will be required for some years to come.

"Construction work on the Transandine line in Argentina, consisting of Siemens new iron poles, with two copper wires, on the routes of the Buenos Aires and Pacific Railway and Argentine Great Western Railway, under contracts with those companies, is progressing satisfactorily. About 500 miles of line, westward from Buenos Aires, has been completed and is in daily use. The whole of this new line, it is expected, will be completed by October next, and with the establishment of the Panama-Colon cable the entire system will be in excellent order."

LONDON UNDERGROUND.

The Underground Electric Railways of London's report of gross earnings for the week ended March 13 and ten weeks ended March 13, 1909, compares as follows:

Company—	1909.	1908.
Bakerloo	£ 3,360	£ 3,005
Piccadilly	5,810	5,285
Hampstead	3,760	3,135
District	9,471	8,853
Tramways	4,743	5,431
Total	£27,144	£25,709
Total to date, ten weeks	276,662	257,216

LITTLE ROCK RAILWAY AND ELECTRIC.

The Little Rock Railway and Electric Company reports earnings for February and two months ended February 28, 1909, compared as follows:

	1909.	1908.
February gross	$54,537	$51,275
Expenses and taxes	25,096	26,849
February net	$29,440	$24,426
Charges and sinking fund	11,033	9,729
Balance	$18,406	$14,696
Reserve fund	3,000	3,000
February surplus	$15,406	$11,696

Earnings for two months ended February, 1909:

	1909.	1908.
Two months gross	$144,441	$106,956
Expenses and taxes	54,640	53,212
Two months net	$ 59,801	$ 53,743
Interest, charges and sinking fund	21,760	19,309
Balance	$ 38,040	$ 34,434
Reserve fund	6,000	6,000
Two months surplus	$ 32,040	$ 28,434

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

THE APPLIER AND ITS USES.

Hartmann & Braun, of Berlin, are introducing an instrument which they have named the "Applier." Its action is based on the principle of induction. Fig. 1 shows one of the fundamental patented forms of the applier, Sp being a coil, E an iron body, part of which can be removed by a handle, and L an open space for receiving the conductor to be examined. Fig. 2 shows one of the finished forms of the apparatus, which is manufactured in several sizes. If the device is clamped to a conductor charged with alternating or interrupted current, a current will be induced in the coil Sp, which may be made audible in a telephone or measured by an instrument. As the applier will indicate currents of 0.01 ampere, it is easy to detect short-circuits or

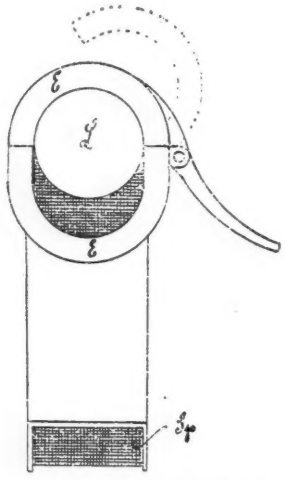


FIG. 1.—DIAGRAMMATIC ARRANGEMENT OF APPLIER.

grounds by its means. In the case of a short-circuit in an installation, for instance, a couple of batteries and a small interrupter are connected to the bus-bars and the lines are followed up with the applier. The telephone will emit a sound up to the place where the short-circuit has occurred, but not beyond, as there will be current in the line. Grounds are located in a similar manner. If a hot-wire alternating-current voltmeter, which also has an ampere scale, is connected with the applier, it may be used for measuring current intensity in alternating-current circuits without disconnecting the lines, by applying it at any easily accessible place, as the fuses. For determining the distribution of the load in large transformer stations, the apparatus is used successively over each fuse and the indications are read off from an instrument. If the latter is well damped, twenty readings can

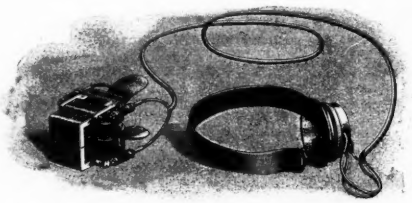


FIG. 2.—COMMERCIAL FORM OF APPLIER.

be easily taken in a minute. For locating blown-out fuses on alternating-current distribution switchboards it is only necessary to apply the device to the fuses in succession and listen, if current is still flowing through them. In order to find grounds in armatures their winding is broken and a battery and an interrupter connected between one of the broken ends and the frame of the machine; alternating currents from a magneto may also be used instead of battery and interrupter. If the applier is then passed around the armature the telephone will emit a sound up to the faulty place and be silent beyond. By sending the current also in the opposite direction from the broken winding the fault may be very exactly located. For many similar tests and measurements the device has proved very useful.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), March 7 and 10.*

CASCADE CONNECTION FOR VARIABLE-SPEED MACHINES.

Before the convention of German Electricians in Hamburg, Profs. Wellner and Kuebler described a number of novel circuit arrangements, generally designated as cascade connections and intended primarily for very irregularly loaded machines. They permit a perfect speed regulation, either automatically or by hand, largely without transformation of the primary energy, as the principal motor is connected directly to the line. These connections are likely to lead the researches in connection with traction problems into a new channel, as they are readily applicable to polyphase as well as single-phase alternating currents. They will greatly reduce the accessories necessary on electric locomotives and obviate the complications attending the use of single-phase commutator motors; thus it is possible to do away with the tension transformer and feed the motor direct; the heavy current consumption at starting and sparking at the commutator are also absent; in point of economy the results are likewise favorable. The arrangements aim at the solution of three problems based on a single principle, which consists in inserting in the circuit of an alternating-current motor with collector rings an independently excited auxiliary motor. The latter machine has its own tension, regulated by its ex-

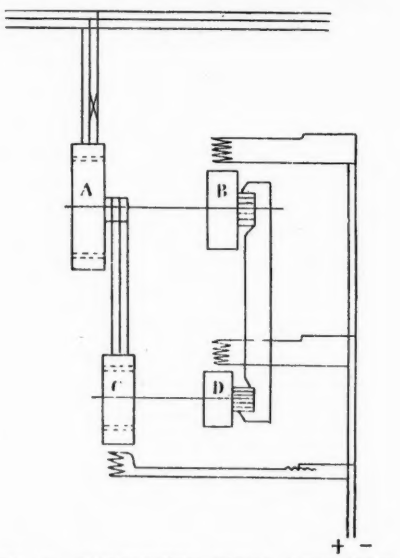


FIG. 1.—CONNECTION WITH AUXILIARY SYNCHRONOUS MOTOR.

citation, which it impresses on the first motor. At the same time it acts as a converter and transforms a part of the energy taken from the principal motor into direct or alternating current of variable frequency. This transformed current feeds directly a second working motor without the intermediary of any coil or resistance. The auxiliary motor plays the double part of a commutator and converter. The application of the system in its simplest form is shown in Fig. 1, in which A is the principal motor, B the second working motor coupled to A, B in this case being a direct-current machine; C a synchronous motor, the auxiliary machine referred

to, and D an auxiliary dynamo connected to C. By changing the excitation of C, the field, the angle of lag and the starting torque of A and B are regulated. The advantages of this method are: great facility of regulation in parallel, normal operation of the machines and simple ar-

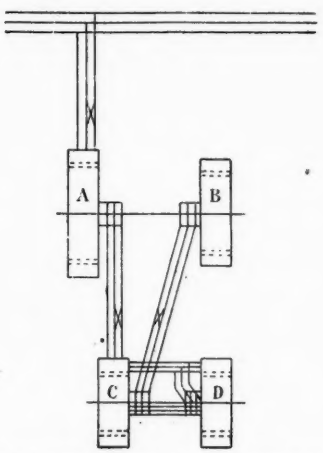


FIG. 2.—CONNECTION WITH AUXILIARY MOTOR.

rangement, good running of all the motors and applicability of the system to direct current. In the second arrangement (Fig. 2) there are two auxiliary motors, C a synchronous motor with collector rings, D an alternating commutator motor, electrically and mechanically coupled with C. D here acts as a gen-

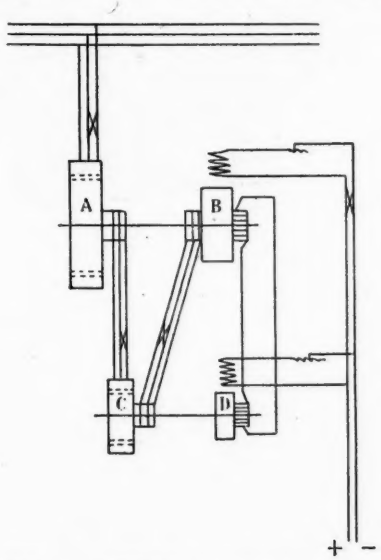


FIG. 3.—CONNECTION WITH ROTARY CONVERTER.

erator and C as motor. Alternating current of a variable number of periods, but always feeble, is taken from the rings of C, while the current furnished by the secondary of A is distributed to both auxiliary machines. The advantages of this system are simplicity of machines A and B, which are two induction motors, suitability for traction, automatic regulation of the energy requirement at varying speeds, automatic and instantaneous adaptation of the speed to the load at all times, possibility of reversing traction motors without the necessity of synchronizing the auxiliary machines. In the third arrangement (Fig. 3), A is the principal motor, B the direct-current motor carrying three collector rings, C the converter also with three rings connected to those of B, D a dynamo coupled to C. The operation is as follows: When the two direct-current machines B and D are not excited, C operates as an asynchronous machine with a small lag, the lag currents being short-circuited through the armature of the direct-current motor. The first starting of motor C takes place asynchronously, simply by disconnecting its rings from those of B and closing them through suitable resistances. If the working motors are at rest, their circuits are closed, and then the direct-current machine D is excited. The current from this machine is divided and flows through the armatures of B and C, and the latter is then excited. The result for C is no slip, this motor running without load; the current of the motor may then be regulated so that the phase displacement is compensated. In order to start the two working motors, the exciting current of B is brought to its normal value and then that of D is increased. When A and B are started, the revolutions of the auxiliary machines decrease and B starts as direct and alternating-current motor at the same time, the direct current being furnished by D and the alternating by C. The chief advantages of this system are that C and D participate in the starting, and therefore their dimensions may be reduced; D can be braked mechanically or electrically; the two working motors can be connected electrically while running. The auxiliary motors may be high-speed machines, so that their mass and weight will be small and of little account. —*Translated and abstracted from L'Industrie Electrique (Paris), March 10.*

WIND-TURBINE ELECTRIC GENERATING PLANT.

A plant recently installed at the works of J. G. Childs & Company in Willesden Green, near London, England, consists of a new form of windmill directly connected with a generator and storage battery for generating all of the current used about the establishment. The windmill is built on a steel tower fifty feet high, and the most novel feature about it is that it has three tails for governing its direction relatively to the direction of the wind. The middle one is at right angles with the plane of the wheel. Two other tails are also mounted back of the wheel at an angle of about fifteen degrees with its plane. One of these side tails is fixed in a vertical plane. The other one and the rear tail are mounted on axes which permit of their rotation without changing the angle between these axes and the plane of the wheel. By making these two tails horizontal the force of the wind bears upon the one side tail only, and, therefore, turns the wheel out of action, since this tail is almost parallel with the plane of the wheel. By twisting the two adjustable vanes more or less the force of the wind upon the wheel is automatically adjusted. At the base of the vertical shaft, which is driven by the wheel, is a pulley from which a belt runs to a vertical-shaft generator, of two kilowatts capacity at 130 volts. The speed of the generator varies from 800 to 1,600 revolutions per minute. To permit of the generation of practically constant voltages, a system of relay switches, energized by the main current, is provided. These switches regulate the resistance in the field circuit, so that as the speed of the generator increases, the field current is weakened. The storage battery is charged by means of this outfit through an automatic switch which cuts the battery in and out of action, depending on the voltage of the generator. Charging is automatically begun when the wind attains a speed above six miles an hour. The entire equipment operates without any attention and runs either day or night, charging the battery sufficiently to provide for all the electric energy consumption about the plant. A large number of lamps, a number of motors, and a small electric elevator constitutes the load. The cost of the equipment, including the battery, was about $750.—*Abstracted from the Electrician (London), March 26.*

Pennsylvania House Passes Subway Bill.

Without a vote against it the Philadelphia Subway bill passed the House on March 30, receiving 177 votes.

It was explained that the measure would apply only to Philadelphia, and would exempt from the constitutional limit upon the city's borrowing power all money borrowed for transit subways and river front improvement.

The bill now goes to the Senate.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Sangamo Ampere-Hour Meter.

The Sangamo Electric Company, Springfield, Ill., has developed an ampere-hour meter, the principle of which is based on the same ideas as are used in its successful direct and alternating-current mercury motor type wattmeters. The ampere-hour meters are for use with electric vehicles, railway train lighting equipment, central station batteries and many other uses where an accurate indication of the current rate and time is imperative.

The Sangamo mercury type meter consists essentially of a copper disc armature

AUTO TYPE SANGAMO AMPERE-HOUR METER, FRONT OF CASE REMOVED.

immersed in mercury contained in a mercury cup or chamber so constructed as to absolutely prevent spilling or escape of mercury in any position in which the meter may be placed. Contacts are imbedded in the walls of the mercury chamber so that current may be led in and out through the mercury and the armature. When the current passes across the magnetic field there will be a stress exerted upon the conductor carrying the current tending to displace it. This is the fundamental principle employed in the Sangamo mercury motor meters.

The accompanying illustration shows the service type ampere-hour meter with the case removed. It will be noticed that the tips of the poles of the mercury chamber are attached to the poles of a large energizing magnet. The armature inside, immersed in the mercury, is subjected to a powerful field on each side of the centre. This permanent magnet takes the place of the potential energizing coil and field used in the standard type Sangamo direct-current wattmeter.

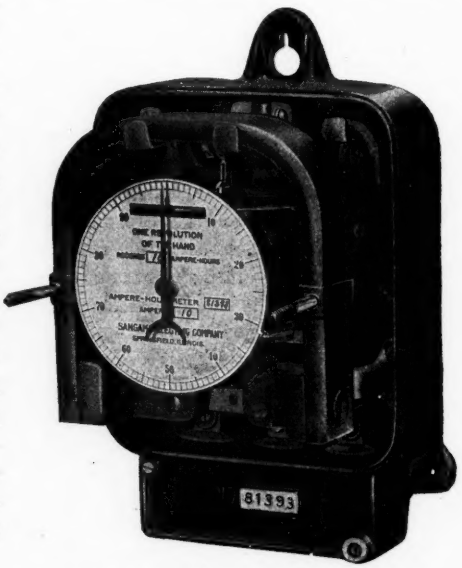
When a current passes through the armature and across the two fields a rotative effect or torque is exerted upon the armature. The amount of this torque and consequently the rate of rotation will vary in the ampere-hour meter according to the amount of current passing through the armature as the field energized by the permanent magnet remains constant. As the meter is designed to rotate at the same rate either forward or backward, compensated windings are unnecessary and there is no light load adjusting device, the potential energizing field being eliminated.

The ampere-hour meter, like the integrating wattmeter, is operated with current shunts. The ten-ampere meter is a standard meter without a current shunt, and in this size the entire line current passes through the armature through the mercury, the meter being capable of carrying an overload of 100 per cent without injury. In capacities of twenty amperes and upward, the armature is shunted by a current shunt placed across the main binding posts of the meter (inside for all capacities up to and including 100 amperes, and located externally to the meter in capacities from 100 amperes and upward). Shunts in capacities up to 15,000 amperes may be supplied.

The ampere-hour meter is remarkably accurate, showing much less variation in its curve from a small percentage of full load to a heavy overload than any previous mercury motor meter. This end is obtained by a special arrangement of the armature, damping disc and permanent magnet.

The ampere-hour meter has a specially designed recording train and dial, differing from that used on integrating wattmeters, as the principal purposes for which it is used do not require a total integrating dial, but rather one designed to show at any time, by the position of a single pointer, the condition of batteries with which the meter is operated. Thus, if it is intended to use the meter on electric vehicles with batteries having a maximum discharge rate of, say, forty amperes, and a capacity of 150 ampere-hours, it would be desirable to use a forty-ampere meter with the recording train geared so that one revolution of the pointer would give 200 ampere-hours. Full discharge of the pointer would then be indicated at three-fourths of a revolution of the hand, and any intermediate position of the pointer would show the absolute condition of the cell.

As the pointer will rotate backward on charge at exactly the same rate that it rotates forward on discharge, it has the additional advantage of acting as an indicator to show when a battery is fully



SERVICE TYPE SANGAMO AMPERE-HOUR METER, FRONT OF CASE REMOVED.

recharged for partial or complete discharge; thus, if an electric vehicle comes into the charging station and the pointer indicates a discharge of sixty per cent of the total rated capacity, the charging current would be kept on until the hand had rotated backward to zero and also to a point beyond an additional amount, which could readily be determined by experience or by obtaining data from the battery makers as to the proper percentage to allow in recharging for internal loss in the battery during discharge.

If the hand has been carried past zero in recharging, it is desirable to have it reset at zero preliminary to starting out with the batteries fully charged. To provide for this, the meter is equipped with a resetting device located just below the

recording train. This device is similar to the pendent set of a watch and is fitted with a detachable key, so that it cannot be operated except by a properly authorized person. By pushing in the key and turning slightly, the hand can be brought to zero from any position without disturbing the mechanism of the meter or the train itself.

The ampere-hour meter is equally valuable for use with electric vehicles, for use with batteries in train-lighting equipments, and for use in showing the floating point of central-station reserve batteries.

In electric-vehicle work, the ampere-hour meter is especially valuable, not only for public-garage service, but for private-garage service, and also for use as a part of the equipment of the vehicle itself. In fact, so important is its function that it is safe to assume that no vehicle equipment will be considered complete without the ampere-hour meter.

An automatic cut-off attachment is fitted to the ampere-hour meter, and any amount of recharge may be determined, the pointer set for this, and upon the completion of its revolution or partial revolution, when the battery is in a fully charged condition, it will be automatically cut out of circuit. This is effected by putting an insulated contact point at the zero on the dial and taking the auxiliary circuit out through a pair of extra binding-posts on the meter, operating a relay battery circuit to open a switch in the charging circuit.

While this form of meter was designed primarily for use in connection with storage batteries, a number of other uses to which it may be put are obvious. One in particular, which is of interest and importance, and which has come up since the meter was developed, is its use in electroplating operations. In this service the meter can be calibrated to read in quantities of metal deposited instead of ampere-hours, and is now used by several of the large silver-plating companies as a controlling device for depositing an exact amount of silver or other metals instead of using the old method of trying to keep the current about constant and plating for a certain length of time.

The Westinghouse Storage-Battery Auto Truck.

The storage-battery auto truck of the Westinghouse Machine Company, first built for service in its own machine shops, proved so successful in transporting large, heavy castings and other shop loads about the plant at East Pittsburg, that a commercial line of these vehicles was designed, and in general service has demonstrated its value in a variety of manufacturing applications.

WESTINGHOUSE BATTERY-DRIVEN 40-TON INDUSTRIAL AUTO TRUCK.

As shown in an accompanying illustration of a forty-ton truck, the car is of extremely simple construction, mounted on four wheels whose two axles are respectively gear-connected to spring-suspended motors. An angle-iron cradle carries the batteries. At the operating end of the truck are mounted the controller, brake, charging receptacle, cut-out switch and volt-ammeter. The deck floor, which is thus clear of all machinery, is made in sections that can be taken up, so that any part of the apparatus can be easily examined.

The motor, which is the Westinghouse vehicle type, is capable of standing heavy overloads, and is dust-proof and self-oiling. The controller gives four speeds in either direction, and is provided with an interlocking reverse lever to protect the motor and battery against premature reversal.

The storage cells have been designed to permit high rates of charge and discharge without injury, making possible a greatly diminished weight of battery in instances where a part of the working time is available for charging, as is usually the case in this class of truck service. The operation of charging has been so simplified that the truck can easily be charged during idle periods. The charging socket on the truck is adapted to receive charging plugs connected with 110 or 220-volt circuits at the various stations throughout the plant. No resistance is used in circuit in the common shop charge of the battery, which is allowed to float on the line, automatically tapering off its current as the charge proceeds. For periodical overcharges a special panel with instruments, circuit-breaker and rheostat, is provided.

Used as a locomotive, the Westinghouse auto truck can haul a load equal to from one-half to its full capacity, and by loading over the drivers to secure adhesion, a haul of twice the full capacity can be maintained for five minutes.

The high efficiency of the Westinghouse storage-battery auto truck is demonstrated by the performance of a certain ten-ton equipment which averaged 700 ton-miles of service per month with an expenditure of sixty-three kilowatt-hours.

These auto trucks require no skilled attendant for operating or ordinary shop charging. They avoid the use of trolley wires and other auxiliary aparatus, and are always ready, independently of the operation of the power plant. The Westinghouse storage-battery auto-truck is made in ten, twenty and forty-ton sizes, for various gauges from standard to eighteen-inch.

Brill Company Increases Forces.

Orders received by the J. G. Brill Company have enabled it to increase the force at its Philadelphia car manufacturing plant to 1,800 men, which is seventy-five per cent of the normal number employed. It is announced that four other plants of the company have a good amount of work on hand, and are employing fifty per cent of their maximum forces.

The company has received a large order from Europe for cars and trucks and is in receipt of many inquiries from all parts of the United States, Canada and foreign countries. There is a notable increase in orders from the Middle West, and the outlook for the company's business is thought to be brighter than at any time for nearly a year and a half.

Special Transformers for Use in Connection with Low-Voltage Tungsten Lamps.

The Kuhlman Electric Company of Elkhart, Ind., has developed a line of special transformers for operation in connection with forty-candle, twenty-five-watt tungsten lamps for sign work running on circuits averaging from ten to twelve volts. These transformers can be furnished for 110-volt or 220-volt circuits, with a ratio of 10 to 1 in the 110-volt and 20 to 1 in the 220-volt sizes, giving a secondary voltage depending on the value of the lighting circuit.

These transformers are built on the regular core type principle, with auto-coil windings, and separate leads for primary and secondary are brought out of the case. The case is constructed of galvanized sheet metal with two hanger-bars riveted to the back so that it can be mounted on a perpendicular wall, or, by the use of a bar, can be arranged to hang on the sign itself.

After the transformer is completed and tested the case is filled with insulating compound, which remains hard under all operating temperatures.

The company announces the following data on performance. The voltage drop is compensated for in the windings and the normal secondary voltage will be maintained at full load. The temperature rise given is calculated by the increase of resistance method after eight-hours run at full load:

Cap. KW.	Watts Core Loss.	Watts Copper Loss.	% Efficiency.	Temp. Rise °C.	Weight, Lb.
¼	14	6¼	92.5	30	24
½	14	8⅞	93.6	31	27
⅔	21	11	94	33	37
¾	25	13	95	35	44
1	29	18½	95.6	38	50

Deltabeston Wire Stands Severe Heat and Moisture Tests for Magnet Wire.

Recently tests have been made to compare the properties of various kinds of magnet wire with those required and covered by the United States government specifications. These specifications read in part as follows:

"When subject to a temperature of 160 degrees centigrade, neither the asbestos covering nor the waterproof compound shall be injuriously affected. Six-inch samples of wire, with carefully paraffined ends, shall be immersed in fresh water at a temperature of twenty-two degrees centigrade for a period of twenty-four hours. The percentage of water absorbed by the insulation during such immersion shall not exceed four per cent."

As the result of these tests, the manufacturers state that Deltabeston magnet wire more than fulfilled the requirements, and the contract was awarded to the D & W Fuse Company, Providence, R. I.

Since this magnet wire was first placed upon the market, every effort has been made for its improvement. Pure fibre is used in the insulation and this is treated to make it indestructible so far as any temperature rise to which it may be subjected in actual service is concerned. In addition to being heatproof, Deltabeston wire is also treated to make it waterproof by thoroughly impregnating the insulation with a compound which prevents the absorption of moisture.

Deltabeston wire is regarded today as a necessary element in service where extreme overloads play an important part. It is made to be especially suitable for use in the manufacture and repair of railway motors, crane motors, air-pump motors, mill motors, lifting magnets, controller blow-out magnets and arc lamps.

The Herrick Planigraph.

A very convenient and readily operated instrument has been manufactured by Spon & Chamberlain of 123-5 Liberty Street, New York city, for quickly solving problems relating to copper conductors for electric circuits. This instrument, known as the Herrick Planigraph, consists of a square card ruled into over forty equal divisions vertically and horizontally and has over twice as many diagonals drawn from the lower left corner as an origin.

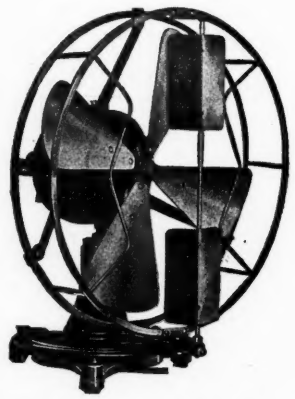
On top is a set of scales of sizes of wire in circular mils and in B. & S. gauge, at the bottom are scales of amperes, at the left of volts drop, and at the right of distances in feet. There are four scales in each set corresponding to values suitable for branches, mains and feeders, railway conductors and long-distance lines. By means of a shifter the four scales can be changed in unison to suit the problem in hand.

Thus with any three of the four variables known the fourth can be readily found. In operating the device the coordinates of two of the known quantities on opposite sides of the diagonals are followed to their point of intersection, from this the diagonal is followed to its crossing of the line corresponding to the third known quantity and from this intersection the line at right angles leads to the desired value on the fourth scale.

Combined Oscillating-Rotating Fan Motor.

Originally looked upon as a pure luxury, the electric fan has now become a commercial necessity, so that today no theatre, assembly hall, restaurant or enclosed place of amusement can hope to retain its patronage during the warm weather without this aid to ventilation, while in offices, factories, or work rooms of any kind the increased efficiency of the employes, when working under proper conditions, is marked. Its use in the home adds to the health and comfort of the family, while in the sick room it is invaluable.

During the past two seasons an increasing demand has developed for the oscillating type of fan, and the indications are that this type will be quite generally used during the coming season.



CENTRAL ELECTRIC COMBINED OSCILLATING-ROTATING FAN MOTOR.

The Central Electric Company, of Chicago, after a long experience in the selling and handling of fan motors, has, with the co-operation of a high-grade factory, developed a line of fans possessing a number of advantages and successful features. These motors represent the latest approved engineering and factory practice, are self-oiling, self-aligning, and embody all the best features of modern construction.

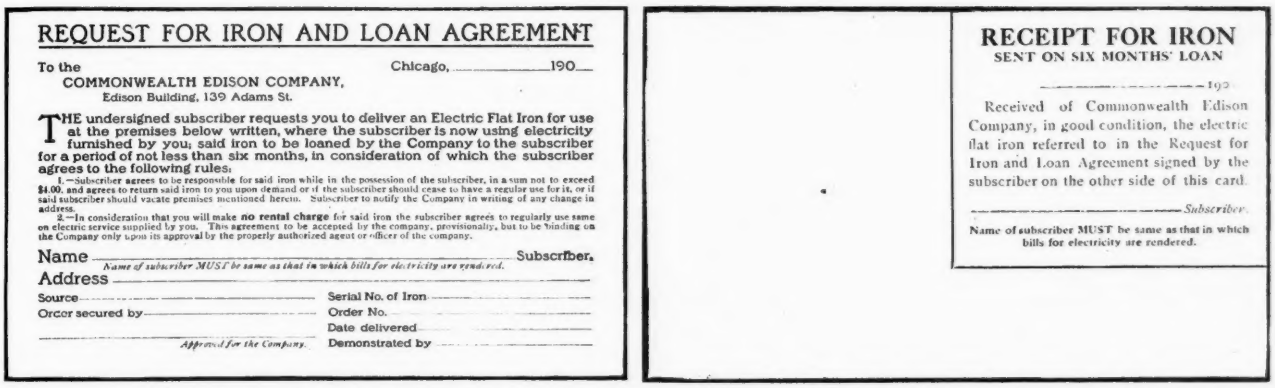
In addition to the qualities of the ordinary oscillating fans, they possess the ability to move backward and forward through any desired angle, or can be converted into stationary fans by simple adjustment. These fans can, therefore, cover a greater range than the ordinary oscillator.

They are built in various sizes in both the alternating-current and direct-current types. Detailed literature relating to them is now being prepared by the company.

The Electric Flatiron Campaign in Chicago.

About four months ago the Commonwealth Edison Company inaugurated an active campaign to popularize the use of electric flatirons in Chicago, 10,000 irons being loaned to its consumers for a six months' free trial. This liberal policy received a ready welcome from the public and the final results will doubtless be very gratifying.

The last of the 10,000 electric flatirons were distributed on March 15, this being ninety days from the time the campaign was started. All of the irons were placed in the hands of customers under the terms and conditions stated on the agreement card reproduced herewith. These irons were delivered by young men especially engaged for this purpose and who were instructed to attach each flatiron and heat it up before leaving it. At the time of delivering the iron each customer was shown just how to use it and was also advised to use it if possible only during the daytime, when the electric lights in the house would not be turned on, thus not making the maximum demand meter show a higher reading than it did before the iron was installed.



REQUEST FOR IRON AND LOAN AGREEMENT

To the COMMONWEALTH EDISON COMPANY, Edison Building, 139 Adams St. Chicago, ____ 190__

THE undersigned subscriber requests you to deliver an Electric Flat Iron for use at the premises below written, where the subscriber is now using electricity furnished by you; said iron to be loaned by the Company to the subscriber for a period of not less than six months, in consideration of which the subscriber agrees to the following rules:

1.—Subscriber agrees to be responsible for said iron while in the possession of the subscriber, in a sum not to exceed $4.00, and agrees to return said iron to you upon demand or if the subscriber should cease to have a regular use for it, or if said subscriber should vacate premises mentioned herein. Subscriber to notify the Company in writing of any change in address.

2.—In consideration that you will make **no rental charge** for said iron the subscriber agrees to regularly use same on electric service supplied by you. This agreement to be accepted by the company, provisionally, but to be binding on the Company only upon its approval by the properly authorized agent or officer of the company.

Name _____ Subscriber.
Name of subscriber MUST be same as that in which bills for electricity are rendered.
Address _____
Source _____ Serial No. of Iron _____
Order secured by _____ Order No. _____
Date delivered _____
Approved for the Company. Demonstrated by _____

RECEIPT FOR IRON
SENT ON SIX MONTHS' LOAN

_____ 190__

Received of Commonwealth Edison Company, in good condition, the electric flat iron referred to in the Request for Iron and Loan Agreement signed by the subscriber on the other side of this card.

_____ *Subscriber.*

Name of subscriber MUST be same as that in which bills for electricity are rendered.

REPRODUCTION OF BOTH SIDES OF COMMONWEALTH EDISON COMPANY'S FLATIRON-RECORD CARDS.

The men who delivered the irons were also authorized to obtain orders for them and as the deliveries were made from a wagon load of irons in the near vicinity it was possible to make very quick delivery after the securing of such orders.

The city was divided into sections, each section being covered by a different crew of solicitors under the supervision of a captain, these captains in turn reporting to a supervisor. This semi-military scheme worked out very satisfactorily and, as the remuneration of the privates, captains and supervisor were all based upon the results obtained, the outcome was a harmonious working out of the plan to a quick and successful finish.

Economic Power Company Loses Suit.

Supreme Court Justice Fitts, sitting at Albany, N. Y., on March 27, gave a decision upholding the constitutionality of the New York Public Service Commission law, and incidentally another phase of the litigation instituted by the Economic Power and Construction Company of Buffalo, to be held outside the pale of the authority of the service board, because it exists by reason of a special charter granted by the state legislature.

Action was brought against the company by the up-State Public Service Commission in October last to enforce payment of the penalty incurred by reason of the refusal of the company to make a report to the commission as required by the Public Service Commission's law. Demurrer to the complaint was served on behalf of the Economic company on the ground that the commission had no jurisdiction over the company because of the unconstitutionality of the law under which it was created, and because of the company being organized under a special legislative act which rendered it free of the jurisdiction of the commission.

The case was argued before Justice Fitts on February 20 last. In his decision Justice Fitts holds that the law is constitutional and that the complaint in the action states a cause of action.

If the strict letter of the Public Service Commission's law was to be enforced in this matter the Economic company would be liable for a penalty of $23,500 for failure to file the report with the commission, this being at the rate of $100 per day up to the date of the beginning of the court action against the company.

Public Service Commission Approves McAdoo Subway Extension.

The New York State Public Service Commission has received a report from its sub-committee, consisting of Chairman Willcox and Commissioner Maltbie, which has been considering the application of the Hudson Manhattan Company to extend its subway to the Grand Central Station, New York city. The committee is in favor of this extension and reports that the original plans of the McAdoo company have been slightly changed with the company's consent, so that the extension will not interfere with the building of any future subways either on Broadway, Thirty-fourth Street, Forty-second Street, or Lexington Avenue. The building of the extension, however, means that the Interborough company will have to remove the eight-foot pipe tunnel recently built without authority between the subway at Forty-second Street and the Steinway tunnel. A public hearing must be held on the form of the grant before the commission can take action; the committee recommends that one be held April 21.

The permission when given to the Hudson company by the commission must be approved by the Board of Estimate.

The Museum of Safety and Sanitation.

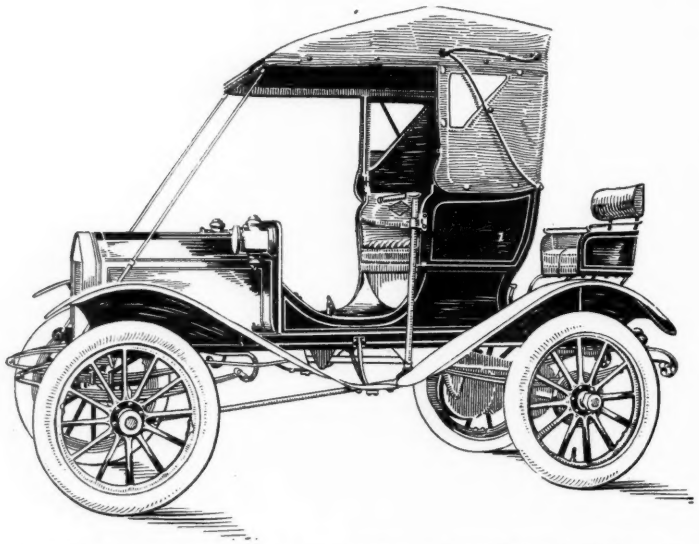
The following officers of the Museum of Safety and Sanitation have been elected: Acting president, Philip T. Dodge; vice-presidents, Charles Kirchhoff, T. C. Martin, Prof. F. R. Hutton, R. W. Gilder; treasurer, Robert Franks. The following committee has been appointed: Plan and scope committee—Prof. F. R. Hutton, William J. Moran, Dr. Thomas Darlington, W. H. Whitfield and P. T. Dodge; director, William H. Tolman.

The Museum of Safety and Sanitation has its office in the Engineering Societies Building, 29 West Thirty-ninth Street, New York city. The objects of the museum are to study and promote means and methods of safety and sanitation and the application thereof to any and all public or private occupations.

Electric Vehicles---1909 Models.

Without a doubt the electric vehicle has many advantages over its principal competitor, the gasoline car, for city and suburban use. Absence of noise and smell, ease of operation, perfection of control, and general reliability, are among the points in its favor, and render it the ideal car for local use. Owing to these advantages, and to its general simplicity, ladies, and even children, can run an electric automobile with perfect confidence after very little tuition.

Up to the present time the principal setback to a more extended use of the electric vehicle has been the recharging and care of the batteries. This is quickly being changed. Central stations all over the country are rapidly taking advantage of the possibilities of the electromobile and are catering to its wants, as providing a use for their current at times when ordinarily the station load is not at a maximum, thus materially increasing their load factor and consequent efficiency of working. Many garages, too, are installing facilities for recharging storage batteries. Indeed, several of them are making a specialty of electric vehicles and have complete electric-generating plants of their own for this purpose.



ANDERSON CARRIAGE COMPANY MODEL L RUNABOUT, CAPE TOP.

An undoubted advantage to the owner of an electric vehicle of any sort, whether for pleasure or business purposes, is to have duplicate batteries. The first cost is, of course, high, and would in many cases be prohibitive, but the economy effected in time of recharging by simply substituting the charged battery for the run-down one, will often amply compensate for the extra initial outlay. Many owners of electric trucks and delivery wagons have already adopted this course and are finding it advantageous and profitable.

The mileage of an electric vehicle for a single charge of the batteries is a question which has raised a great deal of controversy, but which it is impossible to answer definitely except for a given set of conditions and no others. It is obvious that a car running on a level asphalt road will go much further on a single charge than if run on a sandy road or up an incline. A pneumatic-tired car will, as a general rule, go further than a solid-tired car, and even with pneumatic tires, differences of as much as fifty per cent have been claimed between various makes of tires. In this connection, however, it may be noted that it is not always the tire which will give the longest mileage that proves most efficient on the scores of efficiency, reliability and expense, in the long run. As a general rule it may be said that the mileage of the ordinary electric pleasure vehicle varies from about forty to seventy-five miles, for a single charge of the batteries, and it is not usually advisable to exceed this latter figure unless the speed of the car is materially reduced. The electric automobile is not primarily intended for touring or long-distance runs, but for town and suburban use, and a car which will run easily and noiselessly for about forty or fifty miles at a moderate speed is what is required for such service.

A noticeable feature of electric passenger automobiles is shown in the similarity of some of the types to the typical gasoline car. The wheel steer is becoming more and more common and the hood over the batteries in front is sometimes even furnished with a wall piece closely resembling the honeycomb radiator, thus making the resemblance, which is closely followed elsewhere in the general lines of the cars, even more startling.

Below will be found, in alphabetical order of the manufacturers, a brief description of some of the principal 1909 models of electric automobiles:

ANDERSON CARRIAGE COMPANY, DETROIT, MICH.

This company manufactures the well-known "Detroit Electric," for which it is claimed that a single charge of its regular battery will run the car 140 miles at 12.5 miles an hour. There are five speeds, of five, eight, thirteen, seventeen and twenty-two miles per hour.

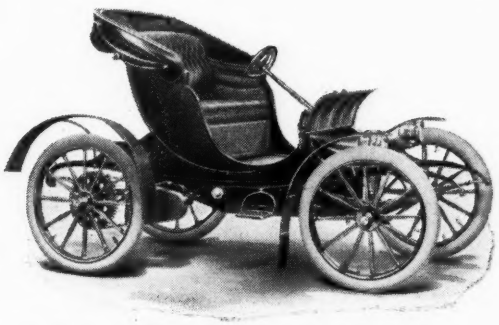
The chassis frame is of cold-pressed steel. The steering knuckles of the front axle are devised so that the wear is received by the pins and hardened bushings, which can be easily replaced when worn. Timken roller bearings are used on both axles. Unusual care and attention have been given to the designing of the bodies, which are strong and light, non-shrinkable and absolutely watertight.

The motor is E. P. type, from two to three horsepower, with high overload capacity. The armature shaft revolves in Hess-Bright annular bearings and requires no attention except occasional repacking with grease. Power is transmitted to a countershaft carrying the differential gear, through a silent-running Renold chain, running in oil, all enclosed in an oiltight case. Adjustment of the chain between the motor and countershaft is made by turning two eccentrics. Other adjustments, of brake and controller, are accomplished by removing the seat cushion.

The controller is operated by a single lever and all the speeds are obtainable, or the alarm may be sounded, or the motor brake applied, without the operator removing his hands from the controller or steering lever. In combination with the controller is a device termed the lock switch, which is operated by the foot through two push buttons in the toe board of the car. This replaces the usual cumbersome running plug and serves also as an emergency switch. As it can only

be unlocked by the proper key it eliminates the risk of having the car stolen when unattended.

The brakes are two in number, one a foot-operated brake operating on both rear bubs, and the other the motor brake, operated by the controller lever. Tires are pneumatic, of any desired standard make, and drive is of the double-chain system.



S. R BAILEY & CO. VICTORIA PHAETON.

The car is made with several bodies, of which the following are examples: Victoria, weight 2,000 pounds; Two-passenger Coupé, weight 2,200 pounds; Four-passenger Brougham, weight 2,300 pounds. All these models are interchangeable on the one chassis, the chief features of which are described above.

The "Detroit Electric" Stock Car Model A recently made a record-breaking run from Detroit to Atlantic City (1,060 miles), on muddy roads, without a broken part and entirely on its own power. The average distance on a single charge of the batteries was eighty-four miles. The car carried two persons and their baggage.

BABCOCK ELECTRIC CARRIAGE COMPANY, BUFFALO, N. Y.

This company, which manufactures several different models of "Babcock Electrics," claims for most of its cars a mileage of 100, and a speed of as high as thirty-five miles an hour on a level road. To substantiate this, a Babcock car has to its credit an official non-stop run of 115 miles on one battery charge.

The chassis of the Model 5 Runabout is of wood, reinforced with steel plates; while that of the other cars is an armored type of special design.

The motor equipments are usually different in the various types of cars. The motors of most of the types are rated at from about twelve to fifteen horsepower actually developed, while in Model 7 Brougham there are two motors, developing together about twenty-five horsepower.

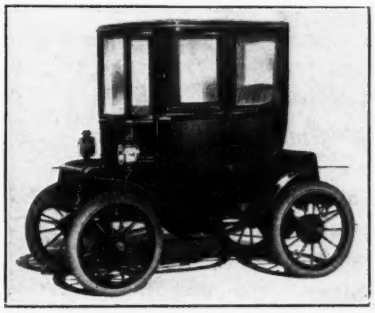
The brakes are hub brakes in the rear wheels and an auxiliary brake on the countershaft, in some of the models, and hub brakes and an electric brake operated by the controller handle, in other models.

The controllers are of special design, giving four or five speeds forward and two reverse, and are equipped with a safety foot-control of exclusive design, rendering accidents practically impossible.

The batteries are specially designed for the particular types of cars on which they are used. Thus, for example, the Model 6 Victoria Phaeton has thirty-six cells, giving speeds of from six to twenty-five miles an hour under ordinary circumstances, while the Model 12 Roadster has forty-two cells, which, it is claimed, will give 100 miles at seventeen miles an hour on level roads, and will develop, if required, a maximum speed of over thirty miles an hour.

The driving gear is of the double-chain variety in some of the cars, and worm-wheel gear in the others.

The principal varieties of bodies of this make of car are: Runabout, Victoria Phaeton, Stanhope, Coupé, Town Car, Roadster and Brougham. Of these probably the Model 6 Victoria Phaeton is the most popular type, although the Model 12 Roadster (see illustration) closely follows in general estimation as judged by the number of recent sales. This latter car is a very handsome affair painted ivory white with gold stripes, and is most reasonable in price. Built on the general lines of the smart gasoline roadster it might at first glance be mistaken for one, were it not so vibrationless and noiseless.



BAKER MOTOR VEHICLE COMPANY EXTENSION FRONT COUPE, P SPECIAL CHASSIS.

S. R. BAILEY & CO., INC., AMESBURY, MASS.

This company has been in the vehicle business for over fifty years, in which they have built up an enviable reputation in light-draft vehicles. For the past three years the company has directed its attention to the perfecting of the Bailey Electric Victoria Phaeton, herewith described and illustrated.

This vehicle weighs complete 2,000 pounds, or without motor, battery, and countershaft, about 825 pounds. The weight is carried low and the battery is hung under the floor by three-point suspension.

The motor is very durable and runs normally at sixty volts. It drives a countershaft through a Morse silent chain and transmission to the rear wheels is effected by double roller chain. The countershaft is of patent construction.

The steering gear is of a lever type, and is actuated by a D-shaped "wheel," the entire column swinging either way at a movement of the hand. The speed control lever, on top of the "wheel," can be actuated by a finger of either hand. This controller interlocks with the switch connecting the battery and motor, so that the power cannot be turned on unless the controller is at the neutral point. It also interlocks with the brake so as to shut off the power automatically when the brake is put on.

The brakes, of which there are three, one on the motor and two on the rear wheels, are operated jointly by one foot lever.

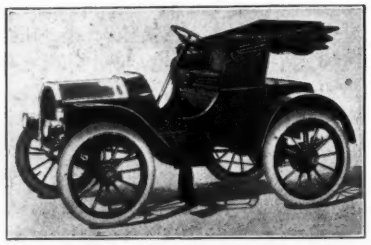
The axles are of a patent pivot type which, it is claimed, will run for a year without oiling, and need never be removed for care or adjustment of the axles. The wheels are of the artillery type.

BAKER MOTOR VEHICLE COMPANY, CLEVELAND, OHIO.

It would be impossible to do justice within the limits of a small article to the varied and magnificent products of the Baker company. Among these may be mentioned the following: Queen Victoria open or full top; Coupés of various kinds, Runabout, Roadster, Brougham, Landaulet, Victoria, Surrey, Stanhope, "Imperial," "Suburban," Light Express Wagon, Commercial Chassis (for express wagons, police patrols, etc.).

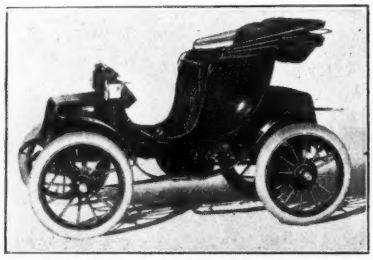
The frames of most of these are of pressed steel, and of the others, armored

wood. Side-lever steering-gear is preferred for several of the smaller cars, and wheel steer for the rest. "Exide" batteries, of from fourteen to forty-two cells each, according to the type of car, are used to supply the power. Transmissions are of the following varieties: silent-chain



BAKER MOTOR VEHICLE COMPANY RUNABOUT, S CHASSIS.

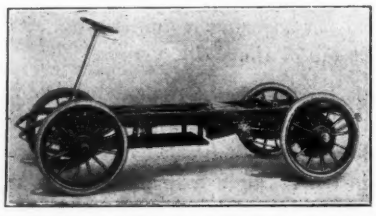
reduction, single-chain drive; planetary-gear reduction, shaft and bevel-gear drive; silent-chain reduction, shaft and bevel-gear drive; single-chain drive—these are for the pleasure vehicles—and silent-chain reduction with double-chain drive



BAKER MOTOR VEHICLE COMPANY QUEEN VICTORIA, P CHASSIS.

from the countershaft to the rear axle, for the Commercial Chassis type.

The motors for the Baker cars are rated at from one-and-one-fourth to three-and-one-half horsepower, with 300 per cent overload capacity. For most of their cars the Baker company conservatively claims



BAKER MOTOR VEHICLE COMPANY COMMERCIAL CHASSIS.

a mileage capacity of about forty miles for a single charge of the battery.

The controller most generally used is one on the continuous torque system, giving six speeds forward and three reverse on one lever, without sparking.

Brakes are of various designs, according to the car for which they are intended. On the lighter pleasure vehicles two foot brakes are employed and have proved very efficient. On some of the other cars two internal brakes on the rear axle are employed together with an internal brake on the transmission shaft operated by the controller lever.

The Baker company announces that it has decided to make the Goodrich Palmer Web Tire its standard equipment, regardless of its extremely high cost.

The demand this season for Baker Electrics seems to be for two and four-passenger inside-driven coupés, victorias, and runabouts.

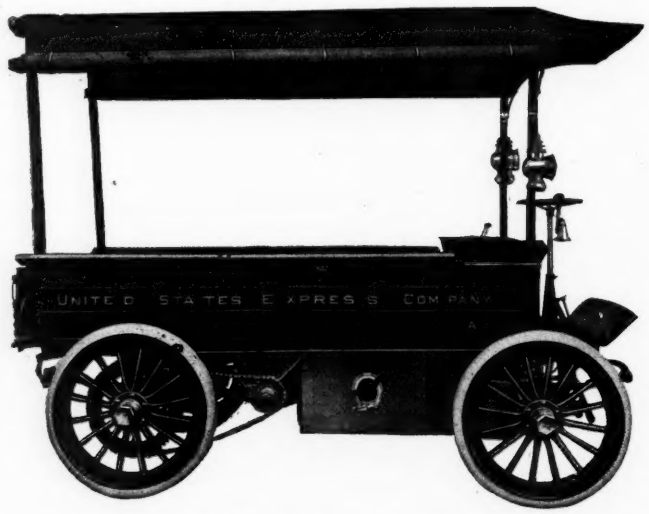
The Baker Motor Vehicle Company has always been conservative in the claims for its cars. It may be interesting to note that in the ten years of its existence the company has sold over 800 cars in its home town of Cleveland. A prophet must at least "make good" to be honored in his own country.

CHAMPION WAGON COMPANY, OWEGO, TIOGA COUNTY, N. Y.

This concern manufactures four types of commercial cars of carrying capacities 1,000, 2,000, 3,000, and 4,000 pounds, respectively. The wheel bases are sixty, eighty-six, one hundred and two, and one hundred and twelve inches; tires (front wheels), two-and-one-half, three-and-one-half, three-and-one-half, four inches, and (back wheels) two-and-one-half, three-and-one-half, four, and two-and-one-half twin, respectively. Transmission in all types is by Morse chain from motor to countershaft and thence by Whitney chain to driving axle. The frames are of channel section, and the weights of the various types of cars are 2,600, 3,800, 4,500, and 6,000 pounds, respectively. The smallest car has six speeds forward and four reverse, and the other cars four speeds forward and two reverse. The mileage capacities are stated to be forty-five miles at fifteen miles an hour (for the smallest car), forty miles at ten miles an hour, thirty-five miles at eight miles an hour, and thirty miles at seven miles an hour, respectively, for the four types.

COLUMBUS BUGGY COMPANY, COLUMBUS, OHIO.

The Columbus Electric, of which there are several graceful models, is equipped with a twenty-four-cell battery, half under the front hood and half under the rear hood, which arrangement, with the motor located under the seat, gives an even distribution of the weight.



CHAMPION WAGON COMPANY COMMERCIAL CAR.

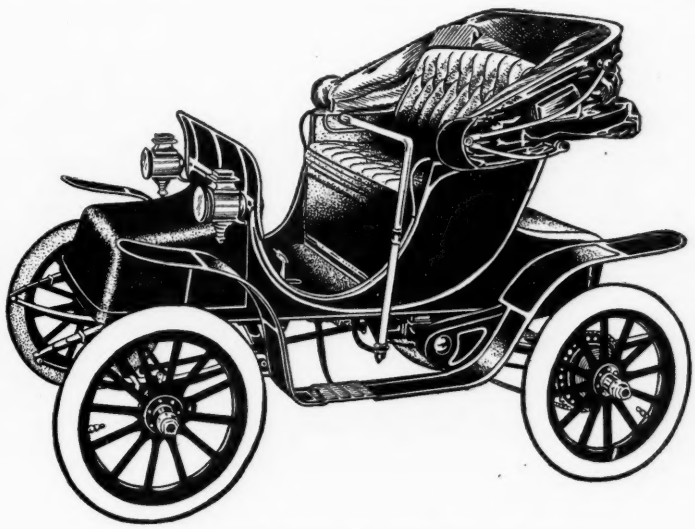
The motor, batteries, controller, wiring, etc., are all easy of access. The body is bolted to the pressed steel chassis frame, but has no part of the machinery attached to it, thus permitting it to be easily removed. All parts interchange and can be replaced easily and quickly.

The batteries, owing to their location, can be inspected and taken care of without removing them from the vehicle. These features are very attractive, for repairs can be made at the minimum cost and in a short time.

The reverse is controlled by a small hand lever at the side of the controlling lever, which, when thrown forward is in the running position; when thrown backward is in the reverse running position; and when upright, is in the neutral position for charging. At this point it is locked unless the controller is in idle position. The open circuit plug is also lo-

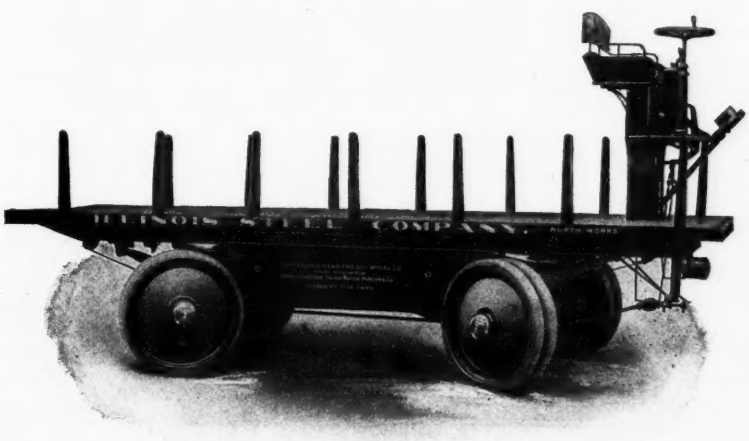
cated by the controller handle, making all operating parts immediately accessible to the left hand.

Double-chain drive is used, and the non-revolving axles, with all bearings revolving in the hubs, reduce friction to a minimum.



COLUMBUS BUGGY COMPANY VICTORIA PHAETON.

All the electrical equipment, including motor, controller, differential gear, and brake, in one unit, is mounted on a subframe, which can be dropped away from the chassis in a few moments by simply loosening four bolts. The entire equipment can easily be inspected from a standing position. All the moving parts run in grease on roller or ball-bearings enclosed in dustproof casings.



COUPLE-GEAR FREIGHT-WHEEL COMPANY FIVE-TON FOUR-WHEEL-DRIVE TRUCK.

COUPLE-GEAR FREIGHT WHEEL COMPANY, GRAND RAPIDS, MICH.

This company manufactures two types of trucks of several models each. One type has the usual storage battery, and in the other this feature is replaced by a gasoline engine and generator. An example of this latter variety was described and illustrated by full-page article in our issue of February 13 last.

The feature of the "Couple-Gear" principle is that the motor energy is transmitted directly to the rim of each driving wheel, thus practically eliminating transmission losses. The company guarantees the "Couple-Gear" to transmit to the wheel at least ninety-seven per cent of the energy developed by the motor.

The four-wheel drive is a new departure for motor vehicles, and one obviously in the right direction. This corresponds with the total-adhesion type of locomotive which is universally adopted by the steam railroad companies for their heaviest freight traffic. The result attained is the maximum developable tractive force for a given power of the motor.

Driving from the front wheels only is adopted in some of the types. This has also many inherent advantages and permits the use of large rear wheels equipped with steel tires, which draw easier and reduce the maintenance cost. To pull out of a rut or over an uneven road, is much easier than to push through the same place. The driving force is always in the direction in which the vehicle is guided, while in driving from the rear wheels the driving force is sometimes nearly at right angles to the desired direction of travel. It is of great assistance to be able to swing the drivers for a "new bite" when in a slippery place. When the rear wheels are in a rut or depression, an increased leverage is had by swinging the front or pulling wheels as is often done with a horse-drawn vehicle.

Steering is accomplished by turning the front wheels, in the front-wheel drive, and all the wheels, in the four-wheel drive. In the latter type the vehicle can be turned in an exact circle if desired. This is an obvious advantage in crowded traffic.

From the general specifications of the Model A Five-Ton Truck the following particulars are extracted: Four-wheel drive and four-wheel steer.—Four motors, three horsepower each. Overload motor capacity 200 per cent.—Transmission, "Couple-Gear." The power is applied at the rim of the wheel with a speed reduction of twenty-five to one and without the aid of countershafts (see description in our recent issue of February 13).—Band Brakes, on all four wheels, operated in two independent groups. Electric brake when specified.—Wheel steering, vertical column, worm and sector principle. All four wheels actuated simultaneously from the single hand wheel.—Frame, "I" beam construction with reinforced oak cross joist.—Axles, truss construction with rods connecting front and rear to battery frame. —Controller, cylinder or street railway type, five speeds forward and five reverse. The car operates and steers equally as well in either direction.—Tire, four inches by thirty-six inches, dual solid rubber side wire, both front and rear, or our new method wood tires when specified.—Battery, forty-four cells 19 W. B. National, Exide, Universal or "Philadelphia."—Body, to suit purchaser.—Speed, five-and-one-half miles per hour with load, six-and-one half miles per hour empty.—Special attachment, for extra speed up to nine miles per hour empty when specified.

"The Gas-Electric" five-ton truck has a forty-horsepower gasoline engine and twelve-and-one-half kilowatt generator in

place of storage battery, otherwise the specifications are the same as above.

Some wonderful performances have been accomplished with "Couple-Gear" trucks. In March of last year the Oliver Machinery Company, of Grand Rapids, Mich., moved its entire equipment to a new location with the aid of a "Couple-Gear" five-ton truck, the largest single load hauled being a thirteen-ton planer loaded on a three-ton trailer. A single piece of machinery weighing twenty-five tons loaded on a trailer weighing six tons was hauled through the streets of New York city in January of this year by a five-ton "Couple-Gear" battery truck, much of the distance (something over a mile) being over a rough Belgian-block pavement with a grade of three per cent, the pillars of the elevated railroad which occupies the street rendering it many times impossible to get a direct pull, and frequent piles of snow lying directly in the path of the truck, making the task still more difficult.

ELECTRIC VEHICLE COMPANY, HARTFORD, CONN.

This concern manufactures the well-known "Columbia Electric" vehicles in addition to a variety of gasoline cars. The victoria phaeton is probably their most popular product, although the brougham and landaulet of this make are widely known and deservedly approved by the best judges.

The body of the victoria phaeton rests on four long, built-up, semi-elliptic springs.

The motor and all mechanical parts are attached direct to the body, thus giving them the benefit of the body spring suspension and making it possible to run at high speeds over rough roads without injury to the mechanism.

The reduction gear and enclosed chain connect the motor to the differential gear on the driving axle which runs in a tubular casing, with all working parts housed to exclude dirt.

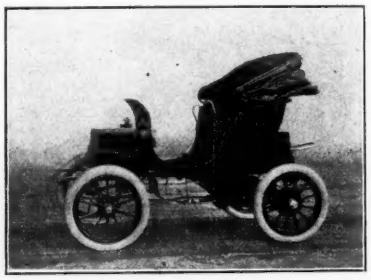
The motor is one of the latest developments of the General Electric Company and transmits its drive through a steel helical pinion and bronze helical gear to a countershaft, and thence by sprocket and chain from the countershaft to the live rear axle. This form of drive insures cleanliness, noiselessness, and high efficiency.

The controller provides four speeds ahead, of four, seven-and-one-half, twelve-and-one-half, and sixteen miles an hour, respectively, and two reverse speeds.

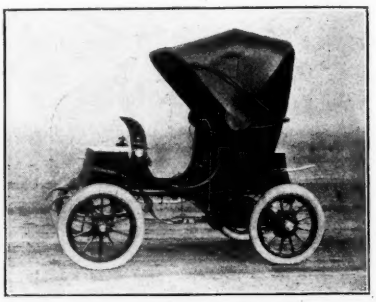
There is a double-acting brake for the rear hubs and an independent emergency brake on a drum on the motor shaft. Both are operated by foot pedals.

The running gear is of the reachless type, flexible, with single motor drive. The steering is accomplished by means of a hinged lever.

This model for the season of 1909 preserves the original outward design in full,



ELECTRIC VEHICLE COMPANY VICTORIA PHAETON, TOP CLOSED.



ELECTRIC VEHICLE COMPANY VICTORIA PHAETON, TOP OPEN.

but embodies three important changes in the mechanism, to wit: the emergency brake, in addition to the regular hub brake; the addition of two extra cells of battery, and the use of Hess-Bright ball-bearings in all four wheels.

GENERAL VEHICLE COMPANY, NEW YORK CITY.

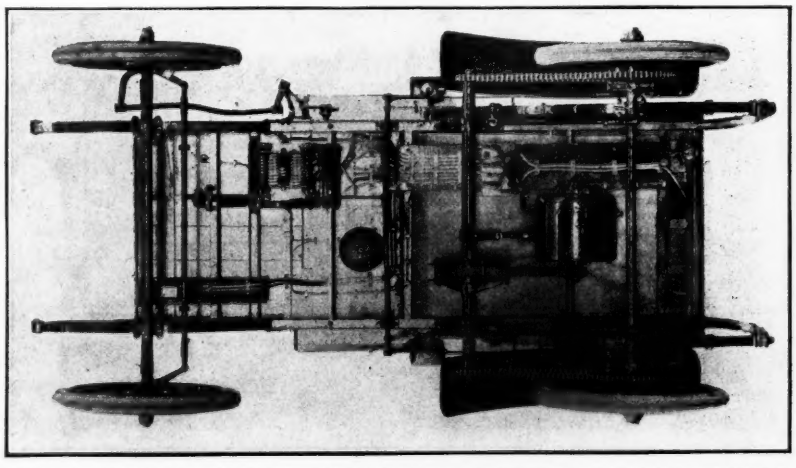
This company, which claims to be the largest builder of commercial vehicles in the world, is building electric vehicles of 350, 1,000, 2,000, 4,000, 7,000 and 10,000 pounds capacity and a mileage of twenty-five to fifty miles on one charge in commercial service, in conditions similar to those in and around New York city. Their three-and-one-half-ton truck, which can go thirty or forty miles every day, is recommended for speed and heavy loads, and is said to be able to do the work of five or six horses every day in the year.

The chasses are uniform in design, but vary in size and power for different capacities. The bodies may be of the standard designs or as required by the customer. The frame is of pressed steel or steel channels.

The battery has forty-four cells and supplies current at eighty-five volts. It is suspended in a cradle below the frame and can be removed entire or in sections from either side of the vehicle.

The controller is of the continuous torque type, operated by a lever, and is placed in an accessible position under the seat.

The motor is built on the advisably heavy lines of the electric railway pattern. The armature shaft runs on ball bearings. The motor is suspended on a cross-bar pivoted to the side frames in front of the rear axle. This pivoted suspension keeps the motor shaft parallel with the countershaft throughout the entire range of chain adjustment and permits the successful use of an efficient silent-chain drive. The motor is totally enclosed and protected from water and dirt at all times. It is high above the ground and may be easily examined from



GENERAL VEHICLE COMPANY—UNDERNEATH VIEW OF 350-POUND DELIVERY RUNABOUT.

the rear by opening a hinged cover in the motor frame.

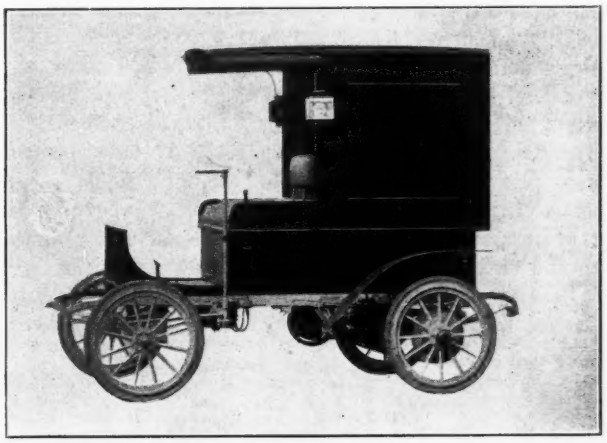
The countershaft is housed and runs on four roller bearings which are enclosed in a tube held in self-aligning ball sleeves supported from the side frames of the chassis by riveted hangers. This countershaft, which may be handled as a single unit, consists of two short shafts connected by a spur-gear differential. Each of these shafts carries a sprocket which drives the roller chain connecting with the rear axle. The countershaft is driven by a broad silent chain over differential gear and motor pinion.

The wheels are of the artillery type with roller-bearing hubs. They carry solid rubber tires which vary in design on the different sizes of vehicle. Twin tires are used on the back wheels in the heavier machines.

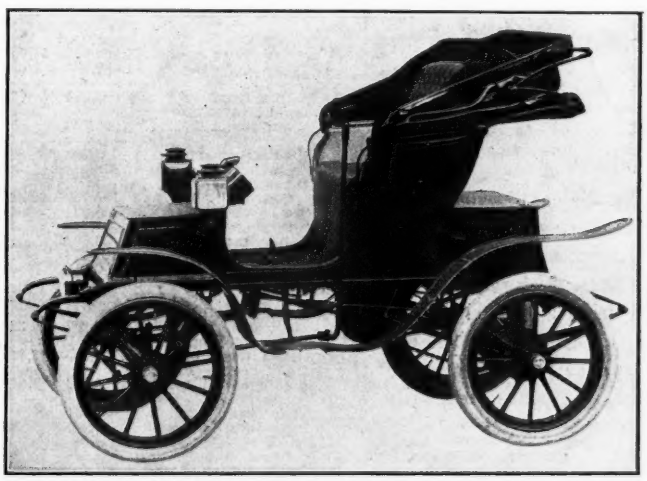
The wheel-operated steering gear is of the gear and sector type. The steering column is vertical.

The brakes are internal-expansion and leather-faced, operate on the rear wheels, and are controlled by a foot lever at the base of the steering post.

GENERAL VEHICLE COMPANY AMBULANCE.



GENERAL VEHICLE COMPANY 350-POUND ELECTRIC DELIVERY RUNABOUT.



STUDEBAKER AUTOMOBILE COMPANY RUNABOUT.

RAUCH AND LANG CARRIAGE COMPANY, CLEVELAND, OHIO.

This firm has been in the carriage business for fifty-six years, which is sufficient guarantee of the reliability of their wares. Their electric carriages are built in a variety of sizes and styles, from the runabout, stanhope and victoria, in the smaller open sizes, and the coupé in the enclosed, to the surrey, brougham and landaulet in the larger and heavier cars. While the appearance, size and style of the various cars are widely different, the general idea as to details of body construction, trimming and mechanical design is the same throughout.

The chassis consists of a cold-pressed steel frame, to which all of the machinery, springs, axles and other parts are attached. The bodies may be interchanged to suit varying conditions of weather.

The motor is of the multipolar type with ball-bearings in dust-proof cases.

The controller is simple and efficient. All connections to and on it are easily accessible. Heavy copper shoes are provided at the points subject to wear. By use of this controller, in conjunction with the battery and motor, all speed changes are made on one voltage, and a continuous torque or pull is obtained throughout the entire range of speeds. The controller handle, which is operated by the left hand, is provided with a safety lock. A forward movement of the handle operates the running speeds, and an extreme backward pull shuts off the power, applies the brakes and stops the car.

All steering is done with the right hand, which rests on a bar fitted with a hand grip. This bar is made so that it can be folded up out of the way when entering and leaving the vehicle.

Two expanding brakes are located in the rear wheels, and are operated by a foot piece in the floor. These brakes are very handy to use when leaving the car, as they can be set and locked. In addition to these there are an electric brake and a mechanical motor brake that can be applied by an extreme backward movement of the controller handle.

"Exide" batteries, assembled in two receptacles, one over each axle, are used. Doors are provided in the hoods for inspection purposes.

The tires are pneumatic or cushion, as desired, although the Rauch and Lang company has adopted the Goodrich-Palmer Web as its standard tire.

The Rauch and Lang Company, besides a very attractive illustrated catalogue, has issued a book of instructions, which, while it applies more especially to

their own particular makes of electric cars, is a veritable mine of information on the subject of automobiles.

STUDEBAKER AUTOMOBILE COMPANY, CLEVELAND, OHIO.

This well-known company manufactures electric passenger automobiles with the avowed purpose for which they are primarily suited, for general utility, convenience and economy, and not for speed records and long-distance runs, for which the gasoline machine is unexcelled.

The four specialties of the Studebaker Company are the Runabout Stanhope, Phaeton, Coupé and Suburban Stanhope, for which speeds of fifteen, fifteen, thirteen and eighteen and one-quarter miles per hour are claimed, respectively. The weights of these vehicles are 1,775, 1,775, 1,990 and 2,300 pounds, in the order named.

The motor is one of special type, with ample overload efficiency to carry the car over reasonable grades.

The batteries of the three first consist of twenty-four cells of eleven plates, and of the last thirty-six cells of nine plates, part carried in front and part in the rear to distribute the weight.

The tires are pneumatic clinchers.

In all these cars one foot lever controls a brake on the rear axle and another a brake on the armature shaft.

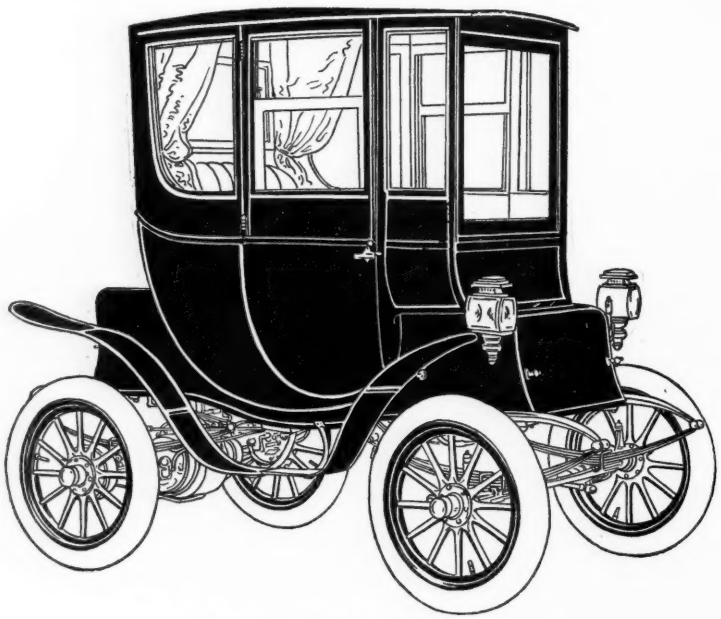
All parts of the cars, with the exception of the batteries and the lamps, tires, rims, horns or other accessories not manufactured by the Studebaker company, are warranted against defects in workmanship for one year.

As instancing the extreme economy of their electrics the Studebaker Company asserts that with the use of a rectifier for charging at home, the maximum cost of a Studebaker electric automobile should not, under normal conditions, exceed $15 a month for maintenance.

THE WAVERLEY COMPANY, INDIANAPOLIS, IND.

A mention of the electric vehicle in the United States would be incomplete without reference to the product of the Waverley plant at Indianapolis.

Originally engaged in the business of manufacturing the well-known Waverley bicycles, the owners of this great factory were among the first to begin experiments with storage-battery propulsion as applied to automobiles.



WAVERLEY COMPANY VICTORIA COUPE.

With an electric car that has outgrown the experimental stage and has long ago solved all those mechanical problems involved in successful storage-battery propulsion, and with a constantly growing demand for this carriage in all quarters of the country, the present success of the company and its future prosperity are assured.

The Waverley people have a design patent on their graceful drop sill, used in their latest models, an arrangement that permits the building of what is probably the most compact carriage bodies in use in any automobile. By lowering the floor of the car the ease of entering and alighting is greatly increased, a factor of some importance to the ladies, while the clumsy mechanical lines affected by some automobile builders are entirely done away with.

Model 75-C is a four-passenger coupé with removable top, permitting the conversion of the carriage into a beautiful victoria phaeton for summer use.

The new controller installed in the latest Waverleys makes it impossible to start except at low speed.

A new driving system is also installed in this model. A special advantage of this driving system is the fact that it is attached to the body instead of the axle and so has the cushioning effect of the springs interposed between its weight and the tires.

Model 74 is also equipped in this way. This is one of the newest Waverley models and is remarkably reasonable in price. This carriage was first exhibited at the Madison Square Garden Show and attracted very great attention and much favorable comment. It must be seen, however, to be appreciated.

Other models are the familiar 70-C and 67, two of last year's favorites, and the Waverley runabout, model 69, of which a phenomenally large number have been sold.

Brooklyn Rapid Transit.

The Public Service Commission has made public the earnings statement of the various companies in the Brooklyn Rapid Transit system for the quarters ended December 31, 1908, and September 30, 1908. The statements of the three most important of these follow:

INCOME ACCOUNT.

	Brooklyn Heights.	Brooklyn Union.	Nassau Electric.
Quarter ending Sept. 30, 1908:			
Gross from oper...	$1,706,047	$1,758,701	$973,660
Exp., including txs.	1,037,033	1,007,563	605,888
Net from oper...	$ 669,014	$ 751,138	$367,771
Income from other sources.....	20,320	58,792	35,981
Gross income....	$ 689,334	$ 809,930	$403,761
Deductions from income as follows:			
Int. on funded and floating debt.....	$ 140,259	$ 422,551	$213,502
Taxes on property.	65,084	45,884	28,869
Taxes on earnings.	22,646	18,174	15,296
Other taxes.....	3,804	.....	1,830
Rentals	387,374	.....	.....
Special approp.....	3,919	.....	141
Total	$ 623,089	$ 486,611	$259,639
Net income from all sources (surplus).	66,245	323,319	144,121
Quarter ending Dec. 31, 1908:			
Gross from oper...	$1,717,963	$1,610,587	$941,499
Oper. exp., exclusive of all taxes.	1,048,744	972,430	696,740
Net earn. from op.	$ 669,218	$ 638,157	$244,758
Inc. other sources.	18,947	31,586	43,879
Gross income....	$ 688,166	$ 669,743	$288,637
Int. on funded and floating debt.....	142,741	424,939	214,122
Taxes on property.	107,458	127,563	36,726
Taxes on earnings.	22,769	16,421	15,153
Other taxes.....	3,804	.....	1,830
Rentals	386,375	.....	.....
Special approp.....	1,144	.....	10,787
Total	$ 664,293	$ 568,925	$278,619
Net income from all sources (surplus).	23,873	100,818	*10,018
Surplus for preced. quarter in fiscal year	66,245	323,319	144,121
Surplus for six months ended Dec. 31, 1908..	$ 90,118	$ 424,138	$154,139

*Deficit.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, MARCH 27.—For some time past there has been in existence an Electrical Trades Benevolent Fund, the object of which is to assist anyone in the electrical industry, no matter what his status, who might have fallen upon evil times. In order to bring the institution more prominently before the notice of those able to support it, a special canvass has been made with very gratifying results, and a dinner is to be held next week, when the announcement will be made of the result. There is also a similar fund administered by the Institution of Electrical Engineers, but the objects of the one mentioned above are on a much wider basis.

Coming at the present moment, in the midst of the London County Council, experiments with surface-contact systems, and the general discussion surrounding this subject, a statement made by the chairman of the Hastings & District Electric Tramways Company is distinctly interesting. As one of the causes of a serious loss, the shareholders have been informed that the expenses of maintaining a short length of the Dolter surface-contact system, which the company has laid down, have exceeded all expectations, no less than 1,068 dead studs having had to be repaired during one year. It is significant that the company, which was a short while ago exploiting the Dolter system in England, is no longer doing so, having come to the conclusion that the overhead system is the only really commercial one.

Considerable progress has been made in the work and equipment of the National Physical Laboratory since the last report. A wavemeter for post office wireless installations has been calibrated, a variable air condenser being used in its construction. An electric furnace room has been erected, and it contains a new carbon tube furnace devised by two members of the staff. A temperature of 2,000 degrees centigrade can be obtained. The equipment of this department includes three other furnaces for testing radiation pyrometers. Thanks to funds provided by the Post Office, the National Telephone Company and the India Office, a machine has been constructed for measuring the tensile strength of long wires. A 100,000-volt transformer supplied by the Westinghouse Company, and taking 20 kilowatts, was installed in September. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, MARCH 27.—There is considerable activity in the Pyrenees region of France in the way of electrical enterprises. One of these is an electric railway project which has been lately authorized and will soon be put into execution. It includes three separate sections of railroad, and one of these will run from Auch to Lannemagan in standard-gauge track, with a second section leading from the intermediate station of Castelnau-Magnoac to Tarbes. The third line runs in standard gauge from Arreau to Saint-Lary. A hydroelectric plant will be erected in the valley of the Oule in order to supply the current for these lines, as well as the already existing electric railroads from Tarbes to Bagneres and others in this part of the Pyrenees region. The Southern Railroad Company is carrying out this work.

An electric railroad line is to be constructed in Austria between Klosterneuberg-Kierling and the town of Gugging, the project having lately been approved by the minister of railroads. A local syndicate has received the concession for building the line. There is also to be constructed an electric road from Koloszvar to Klausenberg, of fifteen miles length.

The Gas and Electric Company of Marseilles has recently put in service a steam turbine group in the Arenc station. It is a 4,000-kilowatt turbine-alternator set, with Curtis wheel, and is built at the Paris works of the Thomson-Houston firm. Previous to this there were installed four 1,000-kilowatt Curtis turbine sets in the same plant, using a battery of twelve boilers. For the new group a battery of eight Niclausse boilers is now set up.

A. DE C.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, APRIL 3.—The Monk Rural Telephone Company has been formed at Carp, Ont., which will operate in a dozen towns and villages. The line will use 120 miles of wire, with an up-to-date metallic circuit.

During the past month, the Marconi wireless station, at Port Morien, Nova Scotia, has on several occasions been in communication with the French government station in the Eiffel Tower, Paris, France. The nature of the signals has not been disclosed. The distance from Port Morien to Paris is considerably over 3,000 miles. The highest previous record made by the Marconi system was between Morien and Clifden, Ireland, 2,900 miles.

The department of lands and forests of the Quebec government has given notice that on May 11 next it will dispose by public auction of a seventy-five-year lease of two very important groups of waterpowers, viz., the Kai-Kai-Ke group and the Island Rapids group, both on the River des Quinze. The first-named group, situated twelve miles from the Indian village of North Temiscamingue, has a total head of ninety-eight feet, and an absolute power, at low water, of 32,980 horsepower. The lessee shall be obliged to expend $250,000 on the development of the waterpower, at this point, within three years. The Island Rapids, which comprise the second group of waterpowers, are eight miles from North Temiscamingue. The difference in level, in these rapids, is ninety-five feet, and there is an absolute power of 32,000 horsepower. The lessee shall be obliged to expend $300,000 in the development and working of this waterpower within three years after the purchase of the lease. The government binds itself not to sell, for ten years, any lands on the banks of the Quinze River on a depth of at least 990 feet beyond the lands surrounding the waterpowers, from the foot of Island Rapids to Lake des Quinze.

WESTERN CANADA.

(Special Correspondence.)

Announcement is made that power will be delivered from the plant of the British Columbia Electric Railroad Company on Coquitlam Lake, near Vancouver, B. C., early in July. This plant is of 10,000 horsepower capacity.

The ratepayers of Melville, Sask., are considering the organization of a local and rural telephone company. Address Leon Benoit, secretary of Board of Trade.

George W. Lang, formerly assistant superintendent of the Ottawa Electric Railroad, Ottawa, Ont., has arrived at Calgary, Alta., where he will enter business.

The Goat River Power Company, Creston, B. C., has secured a charter to build a ten-mile electric tram line to Port Hill, Wash. Work will be started this spring.

At Heward, Sask., a rural telephone company is being organized. Address John Stuart, Heward, Sask.

The City of Brandon, Man., has made application to the City Council at Winnipeg, Man., for power from its plant now under construction at Point du Bois. The power would have to be transmitted some 200 miles. Cecil B. Smith, civic expert, Winnipeg, Man. R.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

LARGE HYDROELECTRIC PLANT FOR IDAHO—A 75,000-horsepower hydroelectric plant is to be built at Cabinet Gorge, on Clark's Fork in Idaho, by the Northern Idaho & Montana Electric Company. The plans call for an outlay of approximately $2,000,000. The plant is to furnish light and power to towns throughout Northern Idaho and Northwestern Montana.

MONSTER POWER DAM PROPOSED FOR RAILROAD ELECTRIFICATION—The president of the Southern Wisconsin Power Company, which controls the mammoth electric project at Kilbourn, said in a recent interview that his company intends to build another dam at Prairie du Sac at a price that will be but a fraction of the present cost. A dam to cost $2,500,000 and the electrification of the Madison-Portage line of the St. Paul road are given as two objects of the company's endeavors. The transmission line from Kilbourn to Watertown will pass through Madison, thus affording that city and the towns in the surrounding district additional power from the Wisconsin River country, provided that the necessary permission can be obtained.

CANADIAN COMPANY SEEKS UNIQUE PRIVILEGES—The Merchants' Light, Heat and Power Company of Montreal, Can., has applied for incorporation. The capitalization is to be $1,500,000, with power to increase this to $3,000,000. The company seeks the power to conduct its operations in the city of Montreal without civic control. It asks for authority to operate in the city within the space marked by Ontario, Craig, Bleury and Papineau streets, doing a general business in electricity and gas. Any mention of any civic control is carefully avoided in the bill for incorporation. The petitioners for incorporation are Odilon Lemire, J. B. Letendre, B. Mercier, A. T. Vallieres, O.

Lecompte, J. O. Lebrecque, W. U. Boivin, N. Beaudry, P. Daoust, A. Lavallee, A. Valiquette, L. J. Tarte, J. B. Baillargeon, J. H. Galarneau, J. Durand, G. Maillet, F. A. Fleury, R. A. Brossard.

THE GREAT NORTHERN RAILROAD PIONEERS THE APPLICATION OF ELECTRIC POWER FOR HANDLING HEAVY FREIGHT—Four big electric motors will be delivered to the Great Northern road in St. Paul, to be used in the movement of heavy traffic in the mountain regions of Montana, Idaho and Washington, and in the tunnels that have been constructed through the ranges. These machines are of the three-phase type, and their use is said to mark a new era in the application of electricity to the movement of traffic. It has cost the road about $1,250,000 to make this new departure and provide the equipment for operating electrically. It claims to be the first road in the country actually to handle freight on heavy grades with anything but steam locomotives.

LARGE HYDROELECTRIC POWER PLANT IN NEW ENGLAND NEAR COMPLETION—The dam for the immense power plant on the Connecticut River, six miles south of Brattleboro, Vt., which is to supply factories with power within a radius of sixty miles, has been finished and the power house itself is near completion. It is authoritatively stated that power will be ready for delivery about June 15. The dam is 650 feet long, not including the foundation of the power house, which is 250 feet long and is built in the river and is really a part of the dam. Wires are being strung on a line of steel towers to Fitchburg, Mass., which will be one of the chief distributing centres, and a line of poles has been built to Brattleboro. The building of the plant has involved an expenditure of more than $1,000,000.

LIGHTING AND POWER

(Special Correspondence.)

OLNEY, TEX.—T. H. Kemp will establish an electric-light plant here.

MINCO, OKLA.—This city is about ready to let the contract for an electric-light plant.

OKEMAH, OKLA.—This city has voted $50,000 in bonds for an electric-light and water plant.

KOOSKIA, IDAHO—The Kooskia Milling and Power Company will install an electric-light plant.

BIRMINGHAM, ALA.—The Big Hillabee Power Company of Alexander City has been incorporated with a capital of $25,000.

AUSTIN, TEX.—A bill has been introduced providing a system of electric power, light and water for state institutions in this city.

TUCKAHOE, N. J.—The Tuckahoe Light and Fuel Company, recently formed in this city, has secured a charter for a town lighting plant.

TRENTON, N. J.—The Sioux City Service Company, an electrical light concern, has increased its authorized capital stock from $25,000 to $2,000,000.

NEW RICHMOND, WIS.—The power plant of the Willow River Lumber Company is to be increased so as to enable the plant to increase its capacity.

PACHUCA, STATE OF HIDALGO, MEXICO—Jose Luis Requena has been granted a concession to install a hydroelectric plant on the Tepeji River. D.

READING, PA.—The stockholders of the Metropolitan Electric Company and the Reading Power Company unanimously agreed to merge the two, with headquarters at Reading.

CHICKASHA, OKLA.—The company operating the power plant on the Washixa River will, in the immediate future, install $50,000 worth of additional machinery with a view to doubling the capacity of the plant.

SAN ANTONIO, TEX.—A new power plant, to be modern in every respect and of a larger size and capacity than any other plant in Texas, will be built by the San Antonio Gas and Electric Company in the near future.

POUGHKEEPSIE, N. Y.—The Hopewell Light Heat and Power Company has been incorporated with a capital stock of $50,000. It will furnish electricity for the towns of East Fishkill, Fishkill, Beekman, La Grange and Wappingers.

DETROIT, MICH.—The Leland Light and Power Company has filed articles of incorporation; capital stock, $30,000. The company will do a lighting and electric power business in Leland and three or four other points in Lenawee County.

MUSKEGON, MICH.—Well-known men here are arranging for a big hydroelectric plant to be erected on White River to furnish power for northern Muskegon County at five cents per kilowatt-hour, with a twenty-four-hour lighting service.

WILKESBARRE, PA.—The Harwood Light and Power Company has commenced operations for the erection of a monster power house at Harwood. Both the power house and boiler houses will be entirely of steel and will be strictly fireproof.

SAVANNAH, GA.—The Savannah Lighting Company has ordered a 1,500-kilowatt Allis-Chalmers steam turbine, which, when installed, will almost double the present capacity of this plant. The company, of which H. LeVaque Wills is general manager, is now putting in two new power circuits.

BERKELEY, CAL.—The Pacific Gas and Electric Company has taken out a permit for the erection of the new power station which the company will construct at Hearst and McGee streets for the transforming of the high power carried into Berkeley preliminary to its distribution locally.

LYNCHBURG, VA.—E. R. Monroe is completing the organization of a company to develop a 5,000-horsepower hydroelectric plant on the Staunton River, twenty-five miles from Lynchburg. The dam will cost 300,000. The company will transmit the power to Lynchburg, Alta Vista and Brookneal.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Power Company is contemplating the installation of an auxiliary steam plant of about 25,000 to 30,000 horsepower to supplement its hydroelectric power plant during the dry season, when the low water is a serious menace to the efficiency of its electric service.

MEXICO CITY, MEXICO—A large hydroelectric plant is being installed by the firm of Veyan, Jean y Company, near this city. A canal from the Alameda River will furnish water for the power, which will be used in lighting this city. The system will be placed in operation by the early fall of next year. D.

BINGHAMTON, N. Y.—An expert electrical engineer has been appointed to estimate the approximate cost of a municipal lighting plant for Lestershire with a view to determining the advisability of its installation. The work will be carried on under the supervision of a lighting committee of three village trustees.

NAVY YARD, PUGET SOUND, WASH.—The steel frame of the new $500,000 central power plant has been erected by the Brown-Ketchum Steel Works. The plant, which is to supply light and power to all the shops of the yard, will be completed and turned over to the United States government early in the summer.

RICHMOND, IND.—The terms of the contract for furnishing electric lights and power to the town of Liberty have been accepted by Robert Asche of this city. Mr. Asche expects also to induce a large number of farmers along the pike between this city and Liberty to make use of electricity for lighting and power purposes.

SPOKANE, WASH.—It is reported that the Portland Canal Mining Company, a $1,000,000 concern, capitalized under the laws of British Columbia, has just completed arrangements whereby $100,000 has been underwritten. During the coming season the company will install a power plant, aerial tram and concentrator at an approximate cost of $75,000.

BROOKLINE, MASS.—William F. Humphrey, chairman; Henry Howard, secretary, and Philip S. Parker, John A. Curtin and Nathaniel Conant, a committee appointed at the annual town meeting in Brookline, March 14, 1907, to consider the question of establishing a municipal light plant, has issued a report which finds the matter inexpedient.

WORCESTER, MASS.—The Sterling selectmen have granted a franchise to the Connecticut Power and Transmission Company on the understanding that the company shall furnish power to Sterling at the rate of two-and-one-half cents per kilowatt-hour, delivered in the centre of the town, this rate to apply to any and all power that the town may require.

PROVIDENCE, R. I.—The firm of H. B. Rust & Company of this city has made an informal offer to take over the electric-lighting plant of the Pascoag Fire District and to run it for a term of either fifteen or twenty years, receiving $4,000 annually for furnishing street lights, and at the end of that time to turn the plant over to its present owners in good condition, at a recent meeting of the Pascoag Fire District.

COLUMBUS, OHIO—An agitation is on foot to adopt the system in vogue in Detroit, where, once a year, in the fall, representatives of each of the wire companies and the city meet and agree upon what portion of the streets shall be cleared of overhead wires, the average amount of work done each year being two miles. All wires enter into one conduit. The expense is lumped and divided equally among the parties interested.

BURLINGTON, N. C.—A franchise has been granted to the Southern Power and Traction Company to enter the city with its lines and furnish power to plants using twenty horsepower or more. This restriction to plants of twenty horsepower was made because of the fact that the city owns its lighting plant, and has just ordered the machinery changed from alternating to direct current, and will furnish day current and power. The Southern Power and Traction Company will build a large dam across Haw River, from which it is estimated 14,000 horsepower will be derived, and has secured franchises to enter Burlington, Graham, Reidsville, Wentworth and other places with its lines.

ELECTRIC RAILWAYS.

(Special Correspondence.)

EL PASO, TEX.—A sum of upward of $50,000 has been raised to start an interurban line.

JEFFERSONVILLE, IND.—Otto W. Pegee has begun a survey for a new traction line between this city and Cincinnati. S.

SPARTA, WIS.—The Sparta-Melrose Electric Railway is now a certainty, as the $300,000 necessary to build the road has all been subscribed.

OKLAHOMA CITY, OKLA.—A special election will be held April 27 to decide whether a franchise for the Oklahoma-El Reno Interurban Line shall be granted.

MONROE CITY, IND.—The building of the Vincennes & West Baden Traction Line has been assured by a favorable subsidy election in Vincennes township.

TOLEDO, OHIO—R. P. Hankey of Detroit, who plans the construction of an Ohio electric line, has sold $800,000 of a $1,000,000 bond issue. Construction of the line will be begun at once.

ST. LOUIS, MO.—Work will begin at once on the new electric line between East St. Louis and Waterloo, and the road will be in operation in about six months. The capital to build the road has been oversubscribed.

JOLIET, ILL.—The interurban electric line being constructed between Joliet and Chicago Heights by the Joliet & Southern Traction Company will be completed about May 1, according to announcement made by President H. A. Fisher.

INDIANAPOLIS, IND.—Judge Carter has granted the petition of the stockholders to order the receiver of the Indianapolis & Newcastle Traction Company to advertise for bids for the completion of the line between Indianapolis and Newcastle. S.

MONTEREY, CAL.—The Pacific Grove & Monterey Electric Railway Company is now making surveys for a new electric road to connect this city with Del Monte Heights and Hot Springs. It is estimated that the undertaking will cost about $35,000. A.

COLUMBUS, OHIO—The Ohio Electric Railway Company, capital $50,000, has been incorporated here to build an electric interurban line from Bucyrus through Tiffin to Toledo. The incorporators are: G. W. Stewart, J. S. Gray, B. F. Whitney, K. Feickert and S. A. Whiting.

EUFAULA, ALA.—At a recent conference held in this city concerning the proposed electric road to connect Eufaula, Abbeville and Dothan, it was agreed to utilize the waterpower of the Choctahatchee River by damming the stream, a permit having been granted by Congress to do so.

ALBANY, N. Y.—The Public Service Commission, second district, has given its approval of a lease by which the Buffalo & Lackawanna Traction Company leases all its corporate property, franchise and privileges to the Buffalo & Lake Erie Traction Company for a term of 999 years.

AKRON, OHIO—The Northern Ohio Traction Company has authorized an issue of $1,000,000 six-per-cent collateral trust notes to be dated May 1, 1909, and to mature in annual installments on November 1, from 1911 to 1918, the proceeds of which will be used to provide for the payment of maturing obligations.

GREENSBORO, N. C.—The electric railway system of the Greensboro Electric Company to the North Carolina Public Service Corporation, a concern backed by Coler & Company, of the New York banking house of W. N. Coler & Company, took place on March 23. The company has a capitalization of $3,500,000. Extensive improvements to the railway, light, power and also the gas service are contemplated. Power is at present contracted for from the Southern Power Company. L.

CHICAGO—Interurban connection between South Bend, Ind., and Chicago was opened on Sunday, April 4, when the first train of Chicago, Lake Shore & South Bend Railway made its way over the new tracks of the Kensington & Eastern Railroad, that was recently given a franchise to act as a connecting link between the Indiana system and the Illinois Central Railroad. Electric power was used up to 138th Street, and from this point through the city to the Kensington station of the Illinois Central steam locomotives hauled the interurban cars.

NEW YORK, N. Y.—The Public Service Commission has granted permission to Receiver Whitridge, of the Third Avenue Railroad Company, to build a single-track extension two-thirds of a mile long on Fort George Avenue. The franchise for this extension was signed by the mayor on March 4 this year. The commission is of the opinion that this extension will not only be of advantage to the Third Avenue company, but will be a convenience to the public and tend to reduce accidents and increase the service at this point where there is so much congestion during the summer months.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

CROAKER, S. D.—The Bradley-Croaker Telephone Company has been incorporated with a capital stock of $24,990.

MANITOWOC, WIS.—The Chicago & Northwestern Railway Company has plans for the complete rebuilding of its telegraph lines to Milwaukee, a distance of 77 miles. C.

SOUTH OMAHA, NEB.—The Independent Telephone Company will shortly commence work on the erection of an exchange at Twenty-fifth and M streets, to cost $15,000. C.

DANVILLE, VA.—The Providence Telephone Company has been incorporated by C. B. Flinttop, of Danville, Va.; D. G. Wilkins, of Blanch, N. C., and others. Capital stock, $5,000. L.

SEATTLE, WASH.—The Seattle Home Telephone Company has applied for incorporation. The capital is $500,000. Incorporators are S. Hill, H. Lindley, E. A. Stuart, M. H. Arnold, W. G. Collins.

HAZLETON, IOWA—The Otter Creek Telephone Company will incorporate under the name of the Hazleton Farmers' Telephone Company. D. N. King, president and general manager; E. J. Short, secretary. C.

HAYMARKET, VA.—The Bull Run Telephone Company has been organized in this town, with $5,000 capital. The president is William Beverly, Broad Run; vice-president, Lee Howdershell, The Plains, Va.; secretary and treasurer, P. D. Brawner, Broad Run, Va. L.

OAKLAND, CAL.—The Home Telephone Company has secured a fifty-year franchise to operate telephone lines in Alameda County outside of the incorporated towns. The company has promised to pay $2,500 and to place all its wires along the Foothill Boulevard underground.

MOORES HILL, IND.—The Moores Hill Telephone Company has filed articles of incorporation and is now in the market for material, equipment and expert labor for the construction of a new telephone system in Moores Hill and adjacent territory. M. C. Mulford is president. S.

FORT WAYNE, IND.—A. L. Lewis, manager of the Great Lakes Radio Telephone Company, has let a contract for the elevation of a 120-foot wireless tower in this city. Mr. Lewis says the plans are all made for the opening of a wireless station at this point in a short while. S.

CONCORD, N. H.—Articles of incorporation have been filed by the Winnipesaukee Telephone Company of Laconia. The capital stock is $180,000. The incorporators are J. N. Keller of Surrey, F. W. Story, Hon. W. F. Knight and C. W. Vaughan of Laconia, and Hon. J. B. Morrill of Gilford.

CARSON CITY, NEV.—The Nevada Telephone and Telegraph Company has recently been granted a franchise to run a line from Tonopah to Reno via Carson and Ely. This will mean the expenditure of nearly $300,000 and will result in cheaper rates for telephoning and telegraphing between the various cities of the state. It is understood that the work of construction will be commenced at once and be completed as speedily as possible.

OBITUARY.

G. CHARLES CONNER, who was for over six years manager of the Philadelphia office of the Sprague Electric Company, died on March 27. He became ill in his office on February 17, and was immediately taken to his home and later to a hospital. Two days later he was operated upon because of an intestinal abscess. Blood poisoning set in, and for a little more than a week he made a hard struggle for life, that was of no avail. The funeral was held at his late residence, 524 Righter Street, Philadelphia, on March 30. The interment was in Indianapolis. Mr. Conner made a large circle of friends by his cordiality, straight business dealings and thorough knowledge of the electrical business. He leaves a widow and a son three years old, to whom sincere sympathy is extended.

WILLIAM H. WAHL, for thirty years secretary of the Franklin Institute, died in Philadelphia on March 23, aged sixty years. He was a graduate of Dickinson College and in 1869 received the degree of Ph. D. from Heidelberg after two years' graduate study at this German university. He was first chosen secretary of the Franklin Institute in 1870 and served four consecutive years. In 1882 he was again chosen to this position and held the office continuously to his death. Last January he was made honorary secretary. Dr. Wahl was at various times editor of the *Polytechnic Review*, *Engineering and Mining Journal* and the *Manufacturer and Builder*, holding the last editorship from 1880 to 1895. As secretary of the Institute he edited the *Journal of the Franklin Institute*. His long and capable service for the Franklin Institute accounted in no small degree for the highly successful work it has conducted. Dr. Wahl was also a special investigator of metallurgical and electrochemical processes.

ELECTRICAL SECURITIES.

Considerable progress was made last week in the bull movement, trading expanding conspicuously and the daily average rising to a point not far below a million shares. General gains were made and the average touched a new high level for the year. Commission house business, however, reports a continuance of public indifference, and there has been little genuine outside buying.

The quarterly dividend of two-and-one-half per cent on the $12,000,000 stock of the Brooklyn City Railroad Company, leased for 999 years to the Brooklyn Heights Railroad Company (Brooklyn Rapid Transit), which guarantees dividends of ten per cent as rental, will be paid April 15. Books closed April 1 and will reopen April 16.

New York:	*Closing.*
Allis-Chalmers common	15⅛
Allis-Chalmers preferred	46½
American Tel. and Tel. Company	131¼
Brooklyn Rapid Transit	75
General Electric	156½
Interborough-Metropolitan common	14⅞
Interborough-Metropolitan preferred	44
Kings County Electric	125
Mackay Companies (Postal Telegraph and Cables) common	73½
Mackay Companies (Postal Telegraph and Cables) preferred	71½
Manhattan Elevated	143
Metropolitan Street Railway	23
New York & New Jersey Telephone	110
Western Union	66½
Westinghouse Manufacturing Company	81½

Western Union officials say the current volume of business is the largest seen since the operators' strike and nearly equals the high record of normal periods. The operating ratio is lower than ever before.

President Winter, of the Brooklyn Rapid Transit Company, in a recent statement, said that the effect of the opening of the subway to Brooklyn upon the traffic on the bridge lines of the Brooklyn Rapid Transit was a reduction of from twelve to fifteen per cent. When the subway was first opened the bridge traffic fell off about thirty per cent, he said, but this has since been reduced to the smaller figure. The subway, instead of hurting Brooklyn Rapid Transit traffic generally, stimulated short-haul business, which had offset the falling off in bridge traffic. The company was also now able to handle this traffic more efficiently. Just now Mr. Winter said the gross revenues of the company are running from $3,000 to $4,000 a day ahead of the receipts at this time a year ago.

Boston:	*Closing.*
Edison Electric Illuminating	258
Massachusetts Electric	72
New England Telephone	132
Western Telephone and Telegraph pref.	

Gross earnings of the Massachusetts Electric Companies for March showed an increase of 4.4 per cent, or $21,800; this is compared with a gain in February of $12,000, or two-and-two-thirds per cent, and a January gain of $21,000, or four per cent. Had the Old Colony Lines done as well as Boston & Northern, the gain for the month would have exceeded six per cent, the actual figures for the two operating companies being a gain of $2,800 for the Old Colony and $19,000, or 6.2 per cent, for Boston & Northern.

Philadelphia:	*Closing.*
Electric Company of America	12⅜
Electric Storage Battery common	46
Electric Storage Battery preferred	46
Philadelphia Electric	11⅜
Philadelphia Rapid Transit	29
United Gas Improvement	90⅞
Chicago:	*Closing.*
Chicago Telephone	132½
Commonwealth Edison	112
Metropolitan Elevated preferred	50
National Carbon common	85
National Carbon preferred	118

Northwestern Elevated's daily average of passengers carried in March increased 13,023, or 12.62 per cent.

PERSONAL MENTION.

MR. WILLIAM MARCONI is to have conferred upon him by the University of Liverpool, the degree of LL.D.

MR. C. H. MINOR, former manager of the Western Electric Company at Omaha, Neb., has been transferred to Kansas City and will be succeeded by L. E. Sperry, assistant manager at Kansas City.

MR. H. L. SHIPPY, formerly treasurer of the John A. Roebling's Sons Company, of New York, is still under medical care at Rome, N. Y., where he is being treated for cancer. Mr. Shippy has passed through a very severe ordeal, and is now reported to be improving, with the expectation of recovery.

MR. W. R. KENNY of Greensburg has been elected superintendent of lighting of the West Pennsylvania Electric Company, with control of its entire electric system. His appointment dates from April 1.

MR. WILLIAM P. HEMPHILL, general manager of the Topeka Independent Telephone Company, has been elected president of the Kansas Independent Telephone Association to succeed W. H. Nelson.

MR. J. F. JONES, formerly of the transformer department of the Ft. Wayne Electric Company, has accepted a position in the transformer sales department of the Wagner Electric Manufacturing Company of St. Louis, Mo.

MR. CYRUS OSBORNE BAKER, the platinum importer, returned to New York the first of the week, after some two months' rest with Mrs. Baker in the pleasant places of Florida. Mr. Baker has completely regained his health.

MR. WALTER L. THOMPSON contributes an interesting article in this issue on the abuses of storage batteries in electric vehicle work. He speaks with authority on this subject, having had for a long period an expert experience with storage batteries of various makes. Mr. Thompson maintains an extensive practice in battery repairing, handling batteries for electric trucks and pleasure vehicles, for lighting and ignition, at his station at 562 West Fifty-second Street, New York city. He is also New York and eastern agent for the Philadelphia Storage Battery Company, Philadelphia, Pa.

PROF. HENRY HUTCHINSON NORRIS was elected on April 3 by the board of trustees of Cornell University directing head of the department of electrical engineering at Sibley College of Engineering. Since the resignation of Prof. H. J. Ryan, four years ago, Professor Norris has been acting head of this department. Professor Norris is well liked by both the students and faculty of Cornell and has won the esteem of all engineers with whom he has come in contact. He is an active member of the American Institute of Electrical Engineers, of whose educational committee he is now chairman. He has taken a prominent part in discussions on engineering education, and is the author of several papers and books on this subject.

DATES AHEAD.

Louisville Electrical Show. The Armory, Louisville, Ky., April 12-24.

Missouri Electric Light, Gas and Railway Association. Annual convention, Springfield, Mo., April 15-17.

Iowa Electrical Association. Annual convention, Cedar Rapids, Iowa, April 21-22.

Iowa Street and Interurban Railway Association. Annual convention, Cedar Rapids, Iowa, April 22-24.

American Electrochemical Society. Next meeting, Niagara Falls, Ontario, May 6-8.

Omaha Electrical Show. Omaha Auditorium, Omaha, Neb., May 6-15.

Southwestern Electrical and Gas Association. Annual convention, Dallas, Tex., May.

Nebraska Electrical Association. Annual convention, Omaha, Neb., May 11-13.

Arkansas Association of Public Utility Operators. Annual meeting, Hot Springs, Ark., May 12, 13, 14.

American Association of Electric Motor Manufacturers. Annual convention, Hot Springs, Va., May 17-20.

Ohio Society of Mechanical, Electrical and Steam Engineers. Annual convention, Canton, Ohio, May 21-22.

West Virginia Independent Telephone Association. Annual convention, Parkersburg, W. Va., May 27-28.

National Electric Light Association. Annual convention, Atlantic City, N. J., June 1-4.

Association of Edison Purchasing Agents. Annual convention, Atlantic City, N. J., June 1-4.

American Railway Master Mechanics' Association. Annual convention, Atlantic City, N. J., June.

Master Car Builders' Association. Annual convention, Atlantic City, N. J., June.

Canadian Electrical Association. Annual convention, Quebec, Canada, June 16-18.

Association of Railway Telegraph Superintendents. Next meeting, Detroit, Mich., June 23.

American Institute of Electrical Engineers. Annual convention, Thousand Islands, N. Y., June 28.

Ohio Electric Light Association. Annual convention, Toledo, July 13-15.

National Electrical Contractors' Association. Annual convention, Toledo, Ohio, July 21-23.

INDUSTRIAL ITEMS.

WICKES BROTHERS, Saginaw, Mich., have issued a new monthly stock list of boilers, engines, dynamos, motors and machinery.

THE HOLOPHANE COMPANY, of New York, announces important changes in prices, discounts, etc., to go into effect April 1. These are contained in Bulletin 21, which is now ready for distribution.

THE CENTRAL ELECTRIC COMPANY, Chicago, is distributing a circular descriptive of its new line of disconnecting switches, fuses, lightning arresters, etc. Copy of this circular will be mailed upon request.

THE F. BISSELL COMPANY, of Toledo, Ohio, is sending out, as usual, its clever monthly calendar cards. The one for April states that "we would like to pin your orders on our line," and shows a miniature clothespin with which to do it.

THE ROBINS NEW CONVEYOR COMPANY, of 38 Wall Street, New York city, has removed its offices and factory to 72 Front Street. The company has leased the entire building, in which greatly increased manufacturing facilities are provided for the expansion of its rapidly growing business.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, is erecting a new factory plant of double its present capacity. The new shops will contain all the latest labor-saving devices, and many new features regarding the general lay-out. It is expected that the new plant will be ready for occupancy some time in the early fall.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., has issued the April number of its "magazinette" called "Trumbull Cheer," which is an illustrated catalogue and price list of switches and stock panels, together with a medley of more or less humorous sayings, jokes and philosophies.

THE PHOSPHOR-BRONZE SMELTING COMPANY is distributing its price list No. 24, dated April 1, 1909. It covers Elephant Brand phosphor-bronze ingots and castings, hardening alloys, rolled and drawn rods and bars, wires and wire ropes, sheets and plates, and gives weights, dimensions and gauges, as well as prices. Copies of this price list can be obtained by addressing the company at 2200 Washington avenue, Philadelphia, Pa.

THE NERNST LAMP COMPANY'S well-known monthly, *The Glower*, contains, in a recent number, besides its descriptions of new installations of Westinghouse-Nernst lamps, the beginning of an interesting article by A. L. Eustice on "Modern Illumination Practice." In the first installment is pointed out the importance of a careful selection of test stations in making an accurate and unprejudiced test of a commercial lighting installation.

THE AMERICAN ELECTRIC FUSE COMPANY, Muskegon, Mich., is distributing some interesting literature devoted to its various specialties. This includes a bulletin describing black enameled wire, a folder describing the American igniter, a data sheet covering an extensive line of telephone protectors and specialties, and a very interesting catalogue describing and illustrating the Allen-Bradley rheostats and electric-controlling apparatus.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has issued catalogue No. 75, entitled "The Standard," Motor Book for 1909. This catalogue illustrates and describes various kinds of small motors for driving grinders, buffers, drills, jewelers' lathes, dental engines, speed lathes, sewing machines, ice-cream freezers, band saws and the like. Small motor-generator sets, dynamotors and steam-engine direct-coupled generator sets are also described.

DOSSERT & COMPANY of New York have received orders for solderless cable connectors during the past week from the General Electric Company for sixty large angle and rectangular back-connecting lugs for 2,000,000 circular mils cable for electric smelting furnaces; from the Southern Wisconsin Power Company for 200 cable taps and ninety-degree angle lugs; from the Electric Appliance Company for 450 two-way connectors, and from E. C. Tibbals & Company for 1,000 front-connected lugs for panels and switches.

THE PETTINGELL-ANDREWS COMPANY, of Boston, has adopted a new trade-mark to appropriately designate its relation to its particular products. In the word "Exemplar," meaning "a model or pattern to be followed or copied, a criterion of perfection," the company believes it has selected a word-motto which the history of its past endeavors makes applicable, and which also sets a standard for its business for all time to come.

THE GENERAL ELECTRIC COMPANY, of Schenectady, N. Y., has ready for distribution a number of new bulletins and circulars. Bulletin 4655 is devoted to a form of electric furnace used for hardening, tempering and annealing purposes; the outfit consists of the furnace proper, a regulating transformer and switchboard panel. Bulletin 4654 treats of section switches for feeder lines; these are mounted in a housing ready for erection on the pole, and are furnished in capacities from 200 to 1,200 amperes. Circular 3757 states the advantages to be derived from the use of tantalum incandescent lamps for the illumination of railroad cars, and contains a reference to the generating outfit designed by this company for use in connection with train lighting. Circular 3761 describes extension diffusers especially adapted for store lighting, where artistic and at the same time scientifically designed incandescent-lamp fixtures are desired. A folder (No. 3765) explains the construction and gives the advantages of bell-ringing transformers, with 110-volt primaries and secondary taps, to give six, twelve or eighteen volts.

THE CROCKER-WHEELER COMPANY, of Ampere, N. J., recently received an order through its Denver office for a number of small motors, to be installed in the plant of the Cox-Clark Engraving Company, Barclay Building, Denver. There will be seven 230-volt direct-current motors from one-half to three horsepower, to be used for individual drive on engraving and electrotyping machinery. One of the largest orders booked by the company during the past week is that for fourteen three-phase, sixty-cycle, squirrel-cage induction motors, aggregating 220 horsepower, for Johnson & Johnson, New Brunswick, N. J. Other induction-motor sales of the week are those for 160 horsepower of the wound-rotor type for the Buffalo Copper and Brass Company, of Buffalo, and a twenty-horsepower for the Frick Company, Waynesboro, Pa. The demand for direct-current apparatus still continues. The Eastwood Wire Manufacturing Company, Belleville, N. J., has ordered a 250-kilowatt, engine-type generator, and the Atlantic Hotel, Bridgeport, Conn., has purchased a thirty-five-kilowatt similar machine. A large rolling mill near Pittsburg has placed an order for 244 horsepower of direct-current motors of the rolling-mill type. Other direct-current sales are those of twenty motors for the Lanston Monotype Machine Company, Philadelphia; a seventy-five-horsepower motor for the W. W. Herron Lumber Company, Mobile, and six motors for the F. P. Little Electric Company, Buffalo.

THE ROLLER-SMITH COMPANY, whose main office is at 203 Broadway, New York city, announces the issue of its first catalogue of electrical instruments, which is now ready for distribution. The following is taken from the foreword catalogue: "The Roller-Smith Company is a consolidation of the Whitney Electrical Instrument Company, whose factory was for years located at Penacook, N. H., with the Switchboard Equipment Company, whose manufacturing plant occupied other premises at Bethlehem, Pa. The forces of both concerns have been retained intact, so that the consolidation has available the more than fifteen years' experience of the Whitney Company in the manufacture of all types of electrical measuring apparatus, and the more than three years' experience of the Switchboard Equipment Company in the manufacture of circuit-protective devices. We would strongly emphasize our long experience, as this is of vital importance in the proper manufacture and design of apparatus in our lines, and should be given serious weight by prospective purchasers." The catalogue contains illustrations and descriptions of electric railway bond testers, decade pattern bridges, circuit breakers of all kinds, direct and alternating current instruments, both portable and switchboard types, ohmmeters, testing sets, etc. There is also given a minute description of the mechanism, operation and use of some of the instruments and other matter of a useful and interesting nature.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the second issue of each month.)

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary, Lloyd Lyon, secretary and auditor Mobile Light and Railway Company, 158 Government Street, Mobile, Ala.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West Thirty-ninth Street, New York, N. Y. Annual convention, Hot Springs, Va., May 17-20.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa. Next regular meeting, Niagara Falls, Ontario, May 6-8.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis Avenue, New York city.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Dr. Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth Street, New York city. Annual convention, Thousand Islands, N. Y., June 28.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, Rossiter W. Raymond, 29 West Thirty-ninth Street, New York city.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th Street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill. Annual convention, Atlantic City, June.

AMERICAN ROENTGEN-RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth Street, New York city.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Forty-seventh Street, New York city.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. P. Folwell, Flatiron Building, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth Street, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, secretary and treasurer Tri-City Railway Company, Davenport, Iowa.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass.

AMERICAN STREET AND INTERURBAN RAILWAY TRANSPORTATION AND TRAFFIC ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth Street, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York city.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, J. E. Cowles, superintendent of lighting Hot Springs Light and Railway Company, Hot Springs, Ark.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

ASSOCIATION OF CAR-LIGHTING ENGINEERS. Secretary, G. B. Colegrove, Illinois Central Railroad, Chicago, Ill.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, D. L. Huntington, second vice-president and manager Washington Water Power Company, Spokane, Wash.

ASSOCIATION OF EDISON PURCHASING AGENTS. Secretary, J. W. Brennan, Edison Illuminating Company, Detroit, Mich. Annual meeting, Atlantic City, N. J., June 1-4.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington Street, Newton, Mass.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Wisconsin Central Railway, Milwaukee, Wis.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick streets, San Francisco, Cal.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada. Annual convention, Quebec, Canada, June 16-18.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 33 Melinda Street, Toronto, Ontario.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Traction Terminal Building, Indianapolis, Ind.

CENTRAL ELECTRIC TRAFFIC ASSOCIATION. Secretary, J. T. Brittson, assistant claim agent Chicago, South Bend & Northern Indiana Railway Company, South Bend, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Colo.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Conn.

ELECTRIC CLUB OF CHICAGO. Secretary, Wm. S. Taussig, 204 Dearborn Street, Chicago, Ill.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRIC RAILWAY GENERAL MANAGERS' ASSOCIATION. Next meeting, Fort Wayne, Ind., May 26.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, George William Russell, Jr., 500 Fifth Avenue, New York city.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine Street, St. Louis, Mo.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, San Francisco, Cal. Monthly meetings, San Francisco, Cal., first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York city. Board of directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau Street, New York city.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt Street, New York city.

ENGINEERS' CLUB OF PHILADELPHIA. Secretary, H. G. Perring, 1317 Spruce Street, Philadelphia, Pa.

ENGINEERS' SOCIETY OF MILWAUKEE. Secretary, W. Fay Martin, Milwaukee, Wis.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. A. Camp, Henry, Ill.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Ottawa, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Preston S. Miller, Engineering Societies Building, 33 West Thirty-ninth Street, New York city.

INDEPENDENT TELEPHONE ASSOCIATION OF TEXAS AND LOUISIANA. Secretary, C. A. Shock, Sherman, Tex.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Frederic Leslie, Muncie, Ind. Next meeting, August 18.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Allen J. Paylow, Rockport, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Davis, Parkersburg, W. Va.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Iowa. Annual convention, Cedar Rapids, Iowa, April 21-22.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, Des Moines, Iowa.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. G. Turpine, Henderson, Ky.

MAINE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, M. E. Crow, Houlton, Me.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill. Annual convention, Atlantic City, June.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MICHIGAN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. A. Burch, Battle Creek, Mich.

MILWAUKEE SOCIETY OF ENGINEERS. Secretary, W. Fay Martin, 456 Broadway, Milwaukee, Wis.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary-treasurer, B. W. Copperthwait, Faribault, Minn.

MISSISSIPPI ELECTRICAL ASSOCIATION. Secretary, J. Abbott, manager Jackson Electric Railway, Light and Power Company, Jackson, Miss.

MISSOURI ELECTRIC LIGHT, GAS AND STREET RAILWAY ASSOCIATION. Secretary, Claude L. Clary, Sikeston Electric Light and Power Company, Sikeston, Mo. Annual convention, Springfield, Mo., April 15-17.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schwerer, Windsor, Mo.

MUNICIPAL LIGHTING ASSOCIATION OF MASSACHUSETTS. Secretary, J. C. Norcross, Reading, Mass.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Annual convention, Toledo, Ohio, July 21-23.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago, Ill.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, Commonwealth Edison Company, Chicago, Ill. Annual convention, Atlantic City, N. J., June 1-4.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb. Annual convention, Omaha, Neb., May 11-13.

NEBRASKA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. E. Mattison, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 60 State Street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meetings held on fourth Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth Street, New York city.

NEW YORK RAILROAD CLUB. Secretary, H. D. Vote, 95 Liberty Street, New York, N. Y.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary-treasurer, John S. Allen, manager, Equitable Electric Light Company, Lake Geneva, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual convention, Toledo, Ohio, July 13-15.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, O. O. Welsheimer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, Frank J. Scherrer, New York city.

ORDER OF THE REJUVENATED SONS OF JOVE. Mercury, C. B. Roulet, Dallas, Tex.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, Dr. Henry M. Stein, Harrisburg, Pa.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Next annual meeting, Louisville, Ky., October 12-14, 1909.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, C. E. Russell, Boston, Mass.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, J. A. Myler, Jr., 608 Juanita Building, Dallas, Tex. Annual convention, Dallas, Tex., May.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York city.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. A. Gould, Ennis, Tex.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby Street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 382 Ohio Street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Chairman, William B. Jackson, 115 Adams Street, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) March 30, 1909.

916,414. ADJUSTABLE INSULATED JOINT. Thomas H. Brady, New Britain, Conn.. Filed February 21, 1908. A joint for gas pipes has an insulating collar into which fits a flaring flange fitted to the upper pipe section and an adjustable collar secured to the lower section.

916,418. RAILWAY SWITCH AND SIGNAL-CONTROLLING AND OPERATING SYSTEM. John T. Cade, Arcola, N. J., assignor to Federal Signal Company, Albany, N. Y. Filed August 8, 1908. A switch or signal-operating device has an electric-controlling circuit, including an induction coil, an indicating device connected with the coil and adapted to indicate the position of the operating device on the breaking of the circuit of the latter.

916,428. SIGNALING. Reginald A. Fessenden, Washington, D. C. Filed November 17, 1905. A receiver for electromagnetic waves comprises a receptacle having a diaphragm provided with a diamond wall perforation and means for causing a flow of liquid through the perforation, terminals being connected to the stream on opposite sides of the diaphragm.

916,429. RECEIVER FOR ELECTROMAGNETIC WAVES. Reginald A. Fessenden, Washington, D. C., assignor to the National Electric Signaling Company, Pittsburg, Pa. Original

application filed July 8, 1903. Divided and this application filed July 3, 1906. This is a modification of No. 916,428.

916,435. SUPPORT FOR ELECTRIC WIRES OR CONDUCTORS. Cornelius C. Gould, Philadelphia, Pa., assignor to Gould Fastener Company, Philadelphia, Pa. Filed March 25, 1908. Consists of a post, a tubular member thereon, a resilient coil encircling the post and a shoulder on the post adapted to be engaged by the wire which is wrapped on the post between the convolutions of the coil.

916,436. JUNCTION-BOX. Edwin T. Greenfield, Kamesha, N. Y. Filed October 19, 1907. The box has side walls and a bottom separate therefrom, the latter being formed with openings for conductors and a flat spring engaging the side walls to secure the bottom and walls together.

916,458. TELEPHONIC RECORDING APPARATUS. Robert D. Lampson, New York, N. Y., assignor of one-half to John H. Thompson, New York, N. Y. Filed December 6, 1907. Combined with the main circuit is a unidirectional operative relay, a local circuit co-operating therewith, a signaling magneto, a printing and recording device controlled by the local circuit and relay, and a time recorder operated by the printing and recording device.

916,459. AUTOMATIC GAS-LIGHTER. Joseph C. Landes, Collegeville, Pa. Filed July 8, 1907. Increase of pressure causes a float to rise, open the valve and close the circuit between two contacts.

916,462. PLURAL-ARC LAMP. Robert E. Leve, New York, N. Y. Filed August 17, 1908. This lamp has two sets of carbons, producing separate arcs and having separate feeding means, but only one means for striking the arcs in unison.

916,476. ELECTRICAL SHOT-FIRING MACHINE FOR MINES. Walter B. McLarty, Wilburton, Okla., assignor of one-half to Jeff T. Boucher, Wilburton, Okla. Filed October 7, 1908. Comprises a generator, a rotatable controller arm, with circuit closers mounted upon it, one of them permanently engaging a contact ring connected to the generator and the others engaging a series of contact points connected with the charges to be fired.

916,483. COMBINATION WIRELESS-TELEGRAPHY INSTRUMENT. John E. Ostrander, Staatsburg, N. Y. Filed September 5, 1907. A coherer has a support therefor forming a contact and means for intermittently moving the coherer out of engagement with the support to break the circuit at the contact.

916,486. BINDING-POST. Henry E. Reeve, New York, N. Y. Filed April 27, 1908. An electrical connector consists of a flat post having screw notches on its opposite edges and a transverse perforation, with a bell mouth and clamping member operable on the notches.

916,505. RELAY. Louis H. Thullen, Edgewood, Pa., assignor to the Union Switch & Signal Company, Swissvale, Pa. Filed March 18, 1905. A rocking frame carries contacts to engage fixed contacts. A winding is provided with a vertically-extending central space and an armature pivotally mounted within this and connected to the rocking frame.

916,537. JUNCTION-BOX. Charles W. Davis, Edgeworth, Pa. Filed October 15, 1908. Has a portion for the reception of busbars and a trough-shaped portion with openings at its ends for the insertion of the cables, combined with means for supporting the busbars and for connecting the cables to them.

916,538. TELEGRAPH-KEY. Floyd W. De Tray, Aurora, Ill., assignor of one-half to Waldo Dennis, Chicago, Ill. Filed August 15, 1907. Consists of a contact element, an actuating device, a second contact element pivotally supported on the device and means engaging the second contact to effect its swinging movement on the actuating device when the latter is operated.

916,541. VARIABLE-INDUCTANCE WINDING. Melville Eastham, Boston, Mass., assignor to Clapp-Eastham Company, Boston, Mass. Filed March 27, 1908. Has a number of inductance wires wound in parallel side by side and a contact movable across the turns of the windings successively, the wires having effective lengths with relation to the contact.

916,548. ELECTRIC FURNACE. Charles W. F. Gorrell, Ottawa, Ontario, Canada, assignor to Marcus Ruthenburg, Lockport, N. Y. Filed April 7, 1906. A furnace electrode comprises a metallic body having a detachable tip of carbon and means arranged to direct a refrigerant through the body and separately to direct a fluid through the tip.

916,549. LOCATION INDICATOR FOR CARS. Emanuel Hagstrom and Gustaf Hagstrom, Lindsborg, Kan. Filed June 15, 1906. A station indicator has an electrically-operated device for shifting an arrester and thus permitting the belt to revolve.

916,552. SUBSTATION TELEPHONE SET. Rasmus Hansen, Sioux City, Iowa, assignor of one-half to Interstate Supply Company, Sioux City, Iowa. Filed December 9, 1907. The arrangement of the cabinet of a wall telephone set with a large writing shelf is described.

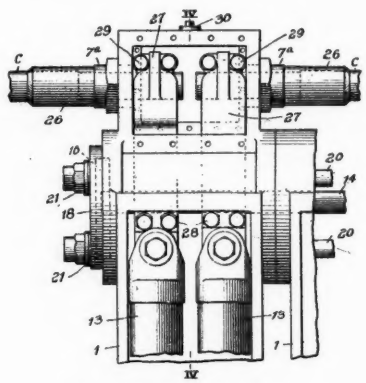
916,572. DETONATING VELOCITY-RECORDER. Hans F. Mettegang, Schlebusch, Germany. Filed February 9, 1906. An apparatus for electrically measuring the action of explosives consists of an isochronously moved recording surface support, of a number of spark inductors subject to the detonation of the explosives tested, and a corresponding number of sparking points marking a number of blank point rows.

916,575. SECONDARY BATTERY. William Morrison, Chicago, Ill. Filed June 8, 1903. Contains an alkaline solution, a negative electrode near the bottom of the cell, zinc and mercury in contact with this electrode, and a positive electrode above the negative one.

916,576. SECONDARY-BATTERY PLATE. William Morrison, Chicago, Ill., assignor to Bulkley, Durand & Drury, Chicago, Ill. Filed June 29, 1903. The active material comprises oxide of lead, sulphuric acid, water, ammonium sulphate and barium sulphate.

916,595. ELECTRIC IGNITER FOR GAS ENGINES. Ira B. Reed, Oil City, Pa. Filed July 27, 1908. Consists of a stationary electrode and a reciprocating one adapted to be moved into and out of contact with it by means of a spring and solenoid plungers.

916,649. CIRCUIT-CLOSER FOR AUTOMOBILES. Theodore A. Backé, New York, N. Y., assignor of one-half to E. Arthur Parker, Brooklyn, N. Y. Filed May 15, 1907. Comprises an internally toothed ring formed of sections insulated from each other, and a rotating tooth contact member adapted to be moved around the toothed ring.



916,537.—CABLE JUNCTION BOX.

916,659. PRODUCING METALLIC INCANDESCENT BODIES FOR ELECTRIC GLOW-LAMPS. Fritz Blau, Berlin, Germany, assignor to Deutsche Gasglühlicht Aktiengesellschaft (Auergesellschaft), Berlin, Germany. Filed June 26, 1906. Consists in sintering the crude filaments in a gas inert relatively to the final products at a white heat obtained by passing a direct current through the material.

916,674. RAILWAY SIGNALING SYSTEM. Clyde J. Coleman, New York, N. Y. Filed July 10, 1908. Combined with the track rails are two relays in operative relation with the track at different points, means for causing one relay to open responsively to the opening of the other and a signal arranged to be controlled by the first relay.

916,688. ELECTRICALLY-OPERATED SINGLE OR VIBRATORY GONG-RINGING DEVICE. Nathan Fallek, Denver, Colo. Filed January 22, 1908. An automatic electrical gong-ringing device for street cars is controlled by the controller arm when it strikes the stop post.

916,694. SPARK-TIMER. Herman W. Gabel, Fond du Lac, Wis. Filed October 14, 1907. Combined with a casing and contact posts mounted therein is a carrier and a firing pin carried thereby and adapted to rub against the contact posts.

916,710. ATTACHMENT FOR TELEPHONE SWITCHBOARDS. Harry S. Janes, Hannibal, Mo. Filed November 26, 1906. Mounted on an indicator board having holes is a card-holding device comprising a plate having flanges on one side and a spring stem with flexible prongs projecting perpendicularly on the opposite side of the plate and adapted to fit the holes.

916,711. AUTOMATIC ELECTRIC FIRE-ALARM. Enos Johnson, Pittsburg, Pa. Filed April 7, 1908. Comprises a signal circuit of main lead wires and a contact wire exercising a

transverse strain on them, there being easily fused insulating material between the contact and lead wires to maintain the circuit normally open.

916,721. DEVICE FOR TIGHTENING OF CABLES. Christian Krâmer, Frankfort-on-the-Main, Germany, assignor to Felten & Guilleaume-Lahmeyerwerke Aktien-Gesellschaft, Frankfort-on-the-Main, Germany. Filed April 16, 1908. Combined with a cable is an electric motor for driving it and a series motor for automatically maintaining its tension, both motors being connected in series.

916,727. TELEGRAPH-KEY. Robert I. Leef, Alhambra, Ill. Filed April 30, 1908. A pivotally-mounted bar has an adjusting screw, above which is located an arm having a finger piece at its outer end and a slotted leaf clamped between the screw and key bar to which the arm is hinged.

916,737. DEVICE FOR CONTROLLING AIR-BRAKES OF RAILWAY VEHICLES AND ELECTROMOTIVE ENGINES. Jacob M. Long, Los Angeles, Cal. Filed May 6, 1907. The apparatus causes the brakes to be applied when the trolley wheel or shoe of a direct-current railway engages with any portion of the overhead or third-rail conductor which has become de-energized.

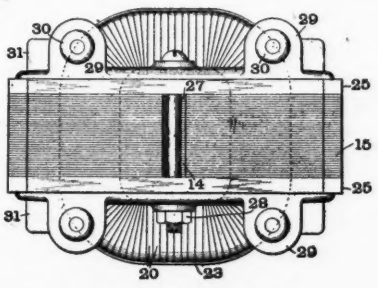
916,741. ARMORED CONDUCTOR. George A. Lutz, New York, N. Y., assignor to American Circular Loom Company, Portland, Me. Filed June 17, 1907. Comprises an insulated cable having a tubular cover composed of longitudinal strips provided with exterior projectings and of a binding material around the cover.

916,742. FLEXIBLE CONDUIT. George A. Lutz, New York, N. Y., assignor to American Circular Loom Company, Portland, Me. Filed June 17, 1907. Consists of a spirally-wound support, longitudinal strips laid thereon and provided with spirally disposed inward projections located between the convolutions of the support and a binder surrounding the strips.

916,743. OUTLET OR JUNCTION-BOX. George A. Lutz, Plainfield, N. J., assignor to American Circular Loom Company, Portland, Me. Filed February 12, 1908. Has integral flanges offset inwardly from the inner walls and surrounding the outlets, thus providing seats without the flanges and knockouts detachably secured in the seats.

916,746. ART OF ELECTRICAL SEPARATION OF PARTICLES FROM A FLUID STREAM. Lawrence N. Morscher, Enterprise, Kan., assignor to himself and William J. Ehrsam Company, trustees, Enterprise, Kan. Filed May 31, 1907. Consists in the maintenance of a current of the particle-laden fluid transversely across a path of a unidirectional convective electric discharge and centrifugally deflecting the particles into spaces beyond the influence of the fluid current.

916,776. ELECTRIC HAND-LIGHTING GAS BURNER. Arthur J. Perkins, Revere, Mass., assignor to Boston Electric Company, Boston, Mass. Filed October 21, 1908. Comprises an oscillating gas cock, a fixed electrode supported by the burner pillar, and a movable electrode carried by a slotted arm so as to come in contact with the fixed electrode when the gas is turned on.



916,792.—TRANSFORMER.

916,789. ELECTRICAL CONTACT BRUSH. Henry K. Sandell, Chicago, Ill., assignor to Mills Novelty Company, Chicago, Ill. Filed December 10, 1908. Consists of a tube having a curved section and forming a holder for a bunch of electric wires.

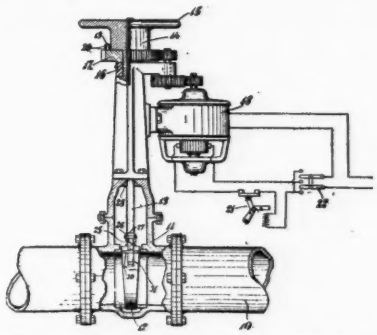
916,792. TRANSFORMER. Hugo F. Selinger, St. Louis, Mo., assignor to Wagner Electric Manufacturing Company, St. Louis, Mo. Filed May 21, 1908. The core and windings are separated by an insulating cell composed of textile material.

916,793. PRODUCTION OF SILICON. George O. Seward, East Orange, N. J., and Franz von Kügelgen, Holcombs Rock, Va., assignors to Virginia Laboratory Company, New York, N. Y. Filed May 14, 1907. Consists in subjecting a porous mixture of silicon and carbon to the heat of an electric arc, whereby the mixture is reduced and the silicon volatilized, the arc being maintained deeply buried under the mixture to provide a cooler zone around the zone of reduction in which the silicon vapor is condensed.

916,812. INCANDESCENT ELECTRIC-LAMP SOCKET. August Weber, Sr., August Weber, Jr., and John Weber, Schenectady, N. Y., assignors to Weber Electric Company, Schenectady, N. Y. Filed July 18, 1904. An insulating cylindrical tube fits within the larger end of the shell and has a part confined between the portion of smaller diameter and the overhanging cut edge of the introverted portion and is adapted to interlock with a snap action.

916,829. LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed July 14, 1904. A "wireless" plural lamp cluster.

916,831. VALVE. John J. Bettinger, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed April 20, 1907. A gate valve is operated by a reversible motor, having an overload circuit-breaker in its circuit.



916,831.—MOTOR-CONTROLLED GATE VALVE.

916,833. POCKET ELECTRIC INCANDESCENT LAMP. Fritz Blau, Berlin, Germany, assignor to Deutsche Gasglühlicht Aktiengesellschaft (Auergesellschaft), Berlin, Germany. Filed April 28, 1906. A pocket flashlight contains a battery movable in the casing, so that the lighting and extinguishing of the bulb is controlled by the mere movement of the battery actuating a protected internal switch.

916,838. COIN-CONTROLLED MECHANISM. Charles F. Burkhart, Buffalo, N. Y. Filed June 4, 1907. A movable frame is actuated by a motor, the circuit of which is normally broken, but adapted to be closed by a coin.

916,840. RELAY. Sewall Cabot, Brookline, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed November 20, 1906. In combination with a diaphragm is an electromagnet arranged to vibrate it, a contact member of easily fusible metal resting upon the diaphragm, all being included in an electric circuit.

916,843. CONTROLLER. Herbert W. Cheney, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed November 1, 1907. A motor controller has its moving member biased backward to off position when in any starting position, and biased forward to off position when in running position.

916,844. ELECTRICAL CONNECTING DEVICE. Edward A. Colby, Newark, N. J. Filed December 14, 1905. A metal thimble formed with a closed end has its open end sealed in an opening in a non-conducting wall.

916,863. OVERHEAD ELECTRICAL CAR SYSTEM. George Heineman, San Francisco, Cal. Filed September 13, 1907. An overhead system of feeders comprises a main supply cable, a number of space blocks supported at its side, a series of insulated distributing wires extending laterally from the cable and engaging the blocks, and a series of resilient contact plates rigidly connected with the blocks and electrically connected with the distributing wires.

916,871. SPARK PLUG. Gabriel P. B. Hoyt, New York, N. Y. Filed March 25, 1908. Consists of an electromagnet with a swinging armature, a fixed and a movable electrode, a spring acting to normally retain them in contact and a pin on the armature to move the electrodes out of contact.

916,877. ELECTRODE FOR ARC LAMPS. Friedrich Kalkner, Nuremberg, Germany, assignor to Siemens-Schuckert Werke G. M. B. H., Berlin, Germany. Filed August 11, 1908. A negative carbon which is relatively much smaller than the positive one has a relatively thick metallic casing surrounding it.

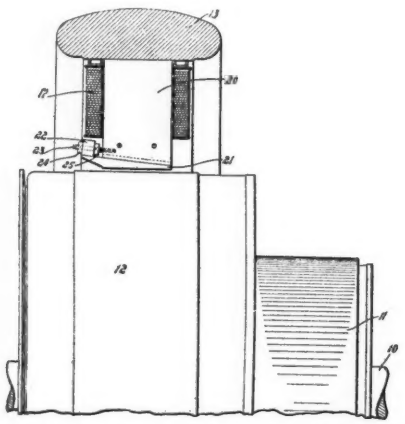
916,879. VAPOR ELECTRIC CONDUCTOR. Osias O. Kruh, Schenectady, N. Y., assignor to General Electric Company. Filed July 11, 1903. A mercury arc rectifier is provided with a single starting electrode adjacent the cathode and a resistance for limiting the starting current.

916,882. RAIL BOND. Albin Light, Spadra, Ark. Filed September 17, 1908. A fishplate provided with bolt openings and a groove extending between them has a bond seated in the groove and provided with sleeves within the bolt openings.

916,895. SPACE TELEGRAPHY. John S. Stone, Cambridge, Mass., assignor to Stone Telegraph and Telephone Company, Boston, Mass. Filed December 14, 1905. An elevated conductor composed of a number of wires has means for connecting a small number of them with the receiving system and for connecting all the wires with the transmitting system.

916,896. RAILWAY SIGNALING. Samuel D. Strohm, Philadelphia, Pa., assignor of one-eighth to Joseph F. Krayer, Philadelphia, Pa. Filed August 29, 1891. A motor car is provided with an automatic switch actuated by an electromagnet under the control of circuit-closing contacts along the track.

916,898. MOTOR-CONTROL SYSTEM. Emmett W. Stull, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed December 31, 1906. The controller consists of two switches, one for connecting the motor in series and in parallel, and a second switch for closing the motor circuit. There are remotely controlled means for closing both switches simultaneously and means for holding the first one closed until the motor circuit is broken.



916,928.—ADJUSTABLE POLE-SHOE FOR COMMUTATING POLE.

916,900. PROCESS FOR ELECTROLYTICALLY PRODUCING PEROXIDE OF HYDROGEN. Gustav Teichner, Nuremberg, Germany. Filed December 28, 1905. Consists in subjecting solutions of persulphuric acid practically free from catalytic agents in a heated condition to an extracting process gradually forming peroxide of hydrogen and separating out the latter as it is formed.

916,905. CARBON FILAMENT AND METHOD OF MAKING THE SAME. Willis R. Whitney, Glenville, N. Y., assignor to General Electric Company. Continuation of applications filed February 8 and 15, 1904. This application filed February 2, 1905. This is an artificial graphite having a metallic temperature-resistance characteristic.

916,909. PLURAL-LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed August 25, 1906. In a casing is a group of circularly arranged lamp sockets and a centrally disposed socket, the corresponding terminals of all being connected together.

916,918. ELECTRICAL CIRCUIT BREAKING AND MAKING DEVICE FOR TELEGRAPHIC PURPOSES. Charles E. Davies, Ottawa, Ontario, Canada. Filed November 27, 1907. Combined with a tiltable armature, and magnet for operating it, is a spring lever having the end adapted to be engaged by the armature in its movement toward the magnet.

916,928. DYNAMO-ELECTRIC MACHINE. David Hall, Norwood, Ohio, assignor to The Bullock Electric Manufacturing Company. Filed January 31, 1906. Between the main poles are commutating poles of which the end portion is adjustable in its entirety and independently of the rest of the pole, whereby the effective length of the pole can be changed.

916,931. CONNECTIVE DEVICE FOR ELECTRICAL CONDUITS AND THE LIKE. Adnah McMurtrie, New York, N. Y., assignor to Thomas & Betts Company, New York, N. Y. Filed December 13, 1907. A connector for flexible armored conduit consists of a housing to receive the end of the sheath and provided with a lateral abutment, a nut lying within the housing and against the abutment being arranged to clamp the abutment and sheath.

916,932. HOODED CONNECTOR FOR ELECTRICAL CONDUITS AND THE LIKE. Adnah McMurtrie, New York, N. Y., assignor to Thomas & Betts Company, New York, N. Y. Original application filed December 13, 1907. Divided and this application filed September 8, 1908. An adaptation of the above method to a junction-box for several flexible armored conduits.

916,937. CONDUIT COUPLING. Robert M. Thomas, Elizabeth, N. J., assignor to Thomas & Betts Company, New York, N. Y. Filed May 22, 1908. A modification of No. 916,931.

916,938. ELECTRICAL BOX COUPLING. Robert M. Thomas, Elizabeth, N. J., assignor to Thomas & Betts Company, New York, N. Y. Original application filed May 22, 1908. Divided and this application filed September 18, 1908. A modification of No. 916,932.

916,950. TRANSMITTER. Rasmus Hansen, Muskegon, Mich., assignor of one-half to Interstate Supply Company, Sioux City, Iowa. Filed May 1, 1907. A telephone transmitter is provided with a slotted bridge having the ends of the slot enlarged, and terminals for leading-in wires mounted in and through the enlarged ends of the slot.

916,957. PRESSURE REGULATOR. Augustus C. Durdin, Jr., Chicago, Ill., assignor of thirty-five one-hundredths to Maurice I. Weil, Chicago, Ill. Filed September 14, 1907. Between two diaphragms controlled by fluid pressure is a tubular connection having a valve therein and motor-controlling mechanism operated thereby.

916,958. ELECTRICAL CIRCUIT CONTROLLER. Herman W. Eichbaum, Venice, Cal. Filed June 8, 1908. An electric motor is controlled by a circuit maker and breaker governed by an electromagnet.

916,959. FIRE GLAZING OR FINISHING OF GLASS ARTICLES. Mark Cummins, Manchester, England. Filed January 9, 1909. Consists in exposing the article under treatment to an electric arc.

Reissue.

12,931. PLURAL-LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed February 23, 1909. Original No. 912,529, dated February 16, 1909. This is a modification of No. 916,909.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired April 5, 1909:

472,026. GALVANOMETER. S. Bergmann and G. A. Scott, New York, N. Y.

472,037. THERMOELECTRIC ELEMENT. E. N. Dickerson, New York, N. Y.

472,062. RHEOSTAT. J. R. Masury, Providence, R. I.

472,084. SAFETY CUT-OUT. M. Thum, Louisville, Ky.

472,124. ELECTRIC RECORDING DEVICE FOR COMPASSES. C. L. Jaeger, New York, N. Y.

472,135. LIGHTNING ARRESTER. E. G. Miller, Wilkinsburg, Pa.

472,193. SYSTEM OF ELECTRICAL DISTRIBUTION. William Marshall, New York, N. Y.

472,237. UNISON APPARATUS FOR PRINTING TELEGRAPHS. H. Van Hoevenbergh, New York, N. Y.

472,243. TELEPHONE TRANSMITTER. E. G. Acheson, Pittsburg, Pa.

472,265. ELECTRICAL METER. J. F. Kelly, New York, N. Y.

472,274. ELECTRIC ARC LAMP. S. W. Rushmore, Brooklyn, N. Y.

472,283. SWITCH-BOX FOR ELECTRIC MOTORS. P. Wright, Denver, Colo.

472,326. AUTOMATIC TELEGRAPH. F. Anderson, Peekskill, N. Y.

472,329. ELECTRIC WHEEL-LOCKING DEVICE. G. W. Blanchard, Waterville, Me.

472,359. ELECTRIC INDICATOR FOR RAILROAD BLOCKS. R. W. Jaggard, Philadelphia, Pa.

472,379. PRODUCTION AND DISTRIBUTION OF ELECTRICITY. W. Marshall, New York, N. Y.

472,444. ELECTRIC MINING PICK AND DRILL. J. Fish, South Bend, Ind.

472,447. INCLOSED SUPPLY SYSTEM FOR ELECTRIC RAILWAYS. J. C. Fyfe, Denver, Colo.

472,480. ADJUSTABLE ARMATURE FOR ELECTROMAGNETS. E. Hofmann. Ballard Vale, Mass.